ON THE ANATOMY, PHYSIOLOGY, AND PATHOLOGY OF THE CHIMPANZEE.

By CHARLES F. SONNTAG, M.D., F.Z.S., Anatomist to the Society, and Demonstrator of Anatomy, University College.

[*From the* Proceedings of the Zoological Society of London, 1923.]

[Published June 1923.]

With C. F. Sonntag's compliments. 31/8/23

[From the PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF LONDON, 1923.]
[Published June 1923.]

On the Anatomy, Physiology, and Pathology of the Chimpanzee. By CHARLES F. SONNTAG, M.D., F.Z.S. Anatomist to the Society, and Demonstrator of Anatomy University College.

(Plates I.–III.*; Text-figures 25–49.)

CONTENTS.

INTRODUCTION.

Zoological literature contains descriptions of parts of nearly three hundred Chimpanzees, but the anatomy of one animal only has been described at any length by Gratiolet (**22**). His account omits many special points, which have also been neglected by other observers, and the same can be said of the works of Sperino (**47**) and Vrolik (**51**), which give accounts of the comparative anatomy of all the Anthropoid Apes. It is, therefore, evident that a full account of one animal is required to serve as a standard for future workers. The present account is based on the examination of a young female, *Anthropopithecus troglodytes*, which died in the Society's Gardens after a residence of two and a half years. And if that species is different from *Troglodytes aubryi* it should be a useful companion to Gratiolet's account of the latter. The animal had the following measurements:—

Length from supra-orbital crests over head and back to anus	23·5 inches
Length from supra-orbital crests to inion	6·4 ,,
,, ,, inion to anus	17·1 ,,
Tip of acromion to centre of antecubital fossa	9·3 ,,
Centre of antecubital fossa to lower end of radius	9·2 ,,
Hand (palm 4 ins.: middle digit 3·2 ins.)	7·2 ,,

* For explanation of the Plates see p. 429.

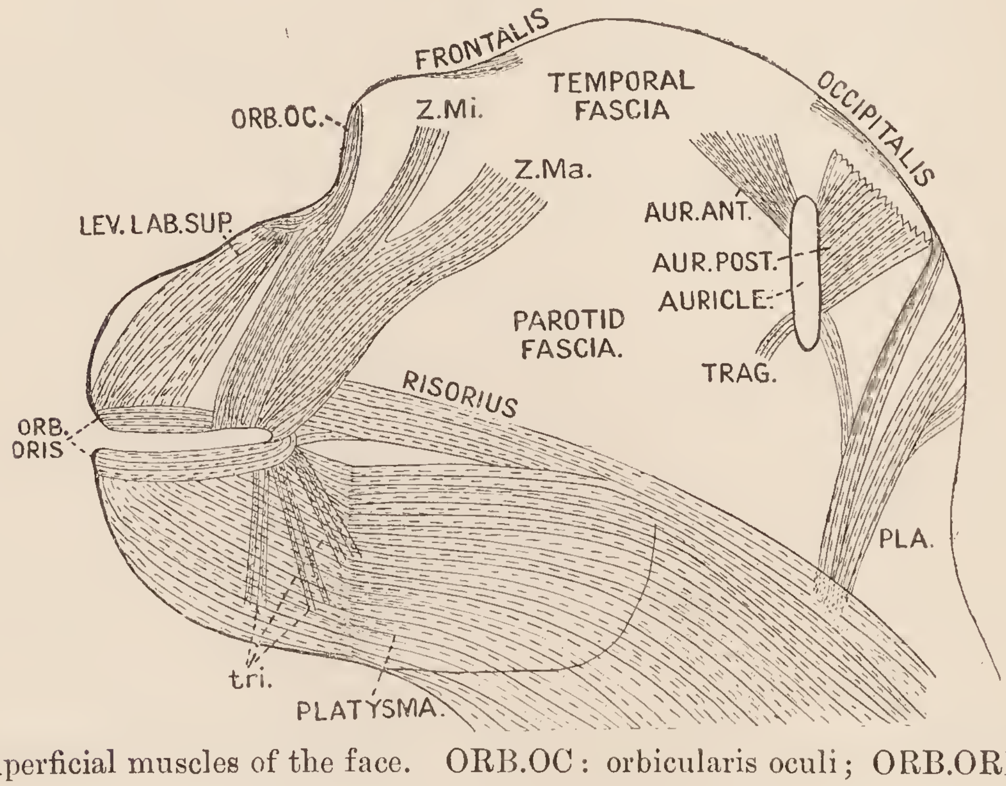
Total length of pectoral extremity	25·7	inches
Great trochanter to centre of patella	9·1	,,
Centre of patella to lower end of tibia	7·6	,,
Foot (sole 4·6 ins.: middle digit 2·8 ins.).........	7·4	,,
Total length of pelvic extremity	24·1	,,
Excess of pectoral over pelvic extremity	1·6	,,

The Muscular System.

Muscles of the Head, Neck, and Back.

The *platysma myoides* (text-fig. 25) is much thicker than in Man. It arises from the fascia over the pectoralis major and deltoid, and the two muscles are inseparable in the middle line of the neck. Its lateral parts are more muscular and thicker than the medial portions. About an inch below the symphysis menti the fibres of the mesial parts decussate (Ruge **42**, Champneys **11**), and I observed the fibres of the left muscle lying superficial to those of the right one; but Quain describes the reverse

Text-figure 25.



Superficial muscles of the face. ORB.OC: orbicularis oculi; ORB.ORIS: orbicularis oris. Other letters in text.

condition in Man. The fibres are attached to the lower border of the mandible, the skin of the lips, and the muscles of the lips and angles of the mouth. But no fibres are attached to the zygoma as described by Champneys. In the face it separates into upper and lower bundles of fibres; the former, corresponding to the risorius in Man, runs to the muscles at the angle of the mouth; and the latter, which is much larger, blends with the skin and muscles of the lower lip. Small fibres, running from the platysma to the angle of the mouth, correspond to the triangularis muscle (*tri.*).

A fan-shaped muscle separates from the platysma in the neck, runs upwards behind the auricle and spreads out into bundles which are attached to the back of the auricle, the occipital crest, occipitalis muscle, and the deep fascia over the back of the neck. Ruge (**42**) has given a very elaborate account of the manner in which the platysma enters into the other facial muscles.

Occipito-frontalis (text-fig. 25):—There are many differences of opinion about this muscle. Tyson (**50**) and Traill (**49**) could not detect it, Owen (**39**) found a trace of it, and Wilder (**53**) found the muscle bellies small, but the aponeurosis was large. Ruge (**42**) figured a very extensive muscle and a small aponeurosis.

In my specimen the occipitalis arises from the middle two-fourths of the occipital crest, but it is not divisible into two bellies as in Man. The fibres pass forwards for nearly two inches and end in a well-marked aponeurosis. The frontalis arises from the supra-orbital ridges and space between, but is not so well-marked as the occipitalis. It is very easily removed with the skin. It blends with the orbicularis oculi.

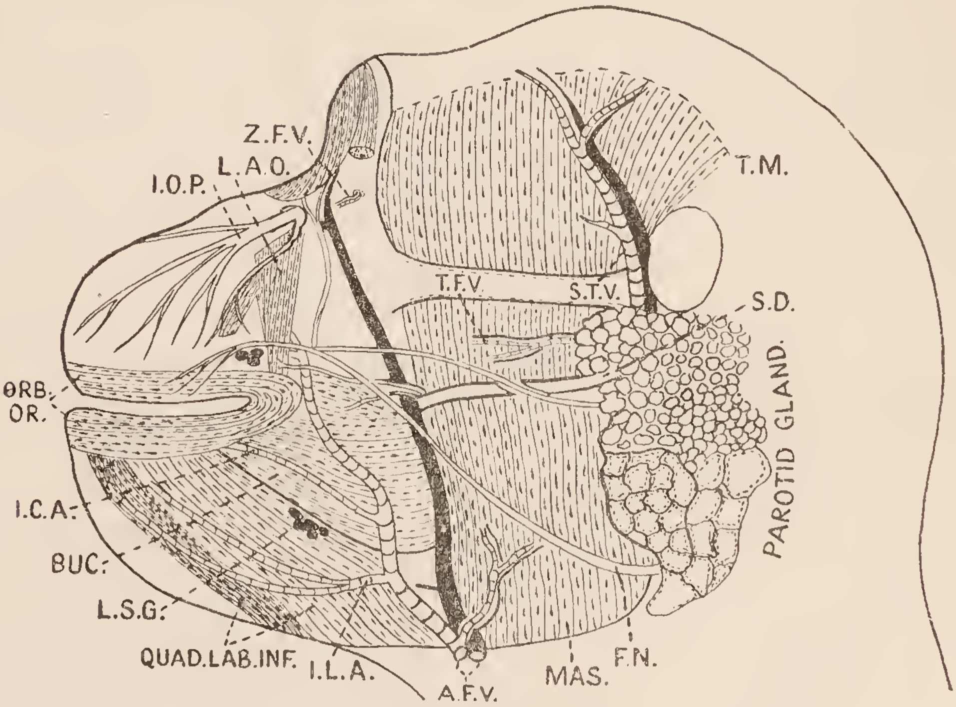
The *Orbicularis oculi* (text-fig. 27 A) is divisible into orbital and palpebral parts as in Man. The former arises from the inner end of the frontal bone and the nasal process of the maxilla; and both muscles are united across the mid line. As it lies on the bones bounding the orbit its upper part is strong and compact and gives off a strong bundle of fibres from its lateral part to enter the zygomatic mass (Z.M). The fibres on the lower boundary of the orbit are arranged in loose bundles. The palpebral fibres run from the internal tarsal ligament to the lateral tarsal raphé, and are thickened close to the roots of the eyelashes, the thickened parts being of greater dimensions than the ciliary bundles (C.B) in Man. At the lateral tarsal raphé the orbital and palpebral parts are continuous. The nerve-supply from the facial nerve is shown in text-fig. 26.

The lips and cheeks receive many muscles (text-fig. 25), most of which, though thin, are of considerable superficial extent. They are disposed in two layers as in Man, but the characters are very different in a number of points. The superficial layer is composed of the risorius, levator labii superioris, zygomatic mass, orbicularis oris, triangularis and quadratus labii inferioris. The deep layer consists of buccinator, depressor anguli oris, incisivi, canini, mentales, and premolares. The *risorius* is composed entirely of the upper part of the platysma, for no fibres are derived from the fascia over the masseter muscle. It blends with other muscles at the angle of the mouth. The *levator labii superioris* (Lev. Lab. Sup) arises, under cover of the orbital part of the orbicularis oculi, from the entire infra-orbital border of the maxilla. It radiates in a fan-like manner and is inserted into the entire length of the upper lip and upper border of the alæ nasi. The fibres forming the latter insertion correspond to the levator labii superioris alæque nasi of Man. Many of the fibres of the muscle are very thin. Champneys (**11**) states that it

is not well differentiated from the levator anguli oris, but that is not the case in my specimen; it is only at their insertions that these muscles are fused. Gratiolet (**22**) describes a mingling of the fibres with those of the orbicularis and they cover the malar-maxillary articulation.

The *zygomatic mass* (text-fig. 25) in my specimen differs from the muscles described by Ruge (**42**), Gratiolet (**22**), and Champneys (**11**). In all the descriptions and published figures it is less powerful, or the parts are more separate. In my specimen it is the most powerful muscle in the face, and has three powerful heads of origin. A strong bundle separates from the orbital part of the orbicularis palpebrarum, the zygomaticus minor (Z.Mi)

Text-figure 26.

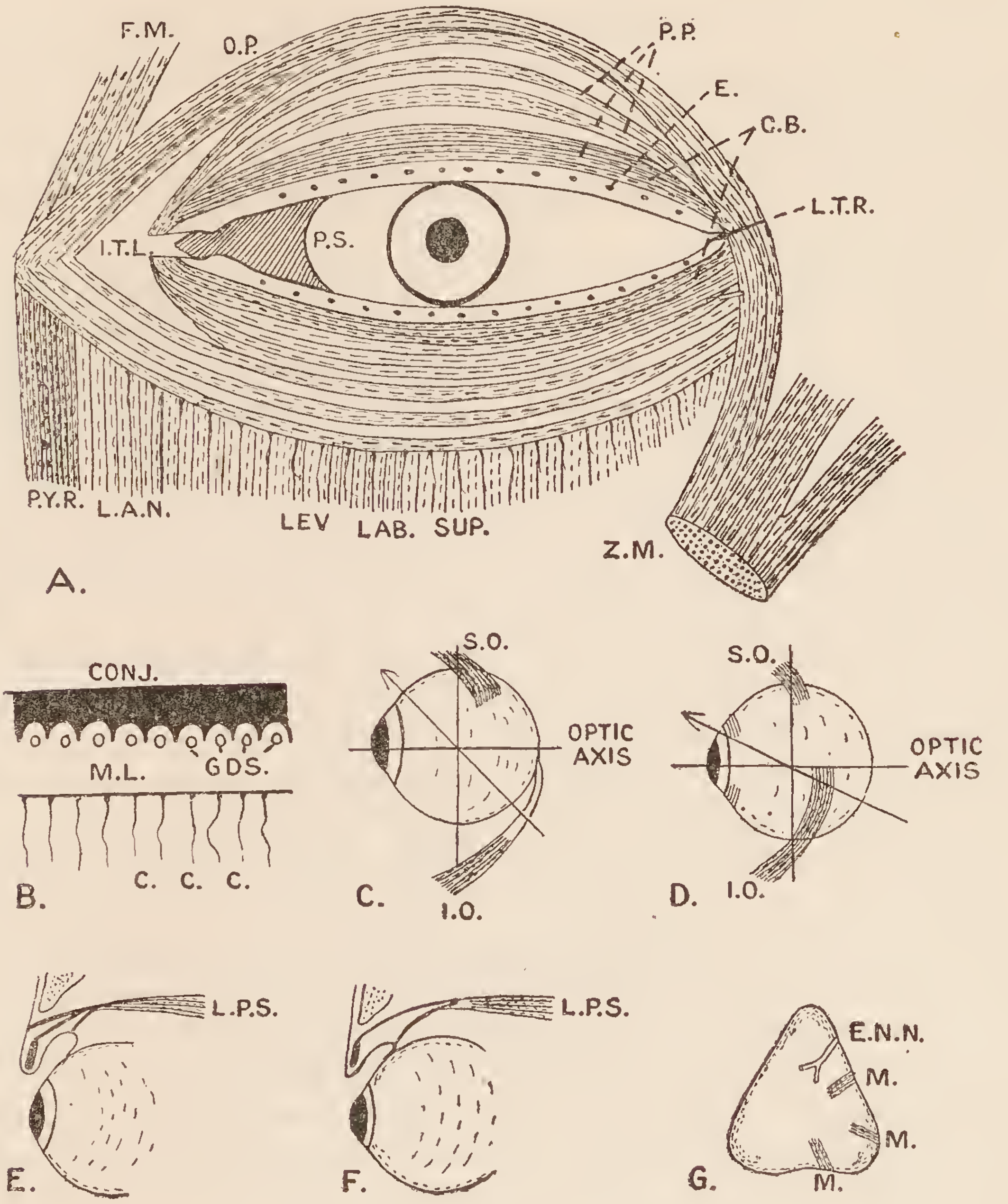


Deep muscles of the face. A.F.V: anterior facial vessels; F.N: facial nerve; I.C.A: inferior coronary artery; L.S.G: labial salivary glands; MAS: masseter; ORB.OR: orbicularis oris; S.D: Stensen's duct; S.T.V and T.F.V: superficial temporal and transverse facial vessels; T.M: temporal muscle; Z.F.V: zygomatico-facial vessels. Other letters in text.

springs from the malar bone and temporal fascia, and the zygomaticus major (Z.Ma) arises from the anterior end of the zygoma. The three heads unite to form a strong muscle an inch wide blending with the muscles of the lips and angle of the mouth. It probably does much more work than the proper levator anguli oris. The *quadratus labii inferioris* (text-fig. 26) has a lower origin than in Man. It springs from the posterior half of the lower border of the outer surface of the body of the mandible. It is in contact with the masseter behind and receives fibres from the platysma below. The fibres course upwards and forwards and blend with those of the orbicularis oris. The anterior fibres are fine and close together, and interlace in the front of the lower lip with fibres of the opposite muscle. Running through the

muscle are branches of the inferior labial artery (I.L.A), and the mental branch of the inferior dental nerve emerges from the mandible underneath it. Champneys (**11**) states that this muscle is not differentiated.

Text-figure 27.



Muscles of the eyelids (A), eyes (C–F) and nose (G): conjunctiva (B). C: cilia; CONJ: conjunctiva; E: eyelids; E.N.N: external nasal nerve; F.M: frontalis; I.O: inferior oblique in the Chimpanzee (C) and Man (D); I.T.L: internal tarsal ligament; L.T.R: lateral tarsal raphé; M.L.GDS: Meibomian glands; O.P: orbitalis; P.S: plica semilunaris; P.P: palpebralis; L.P.S: levator palpebræ superioris of Man (E) and the Chimpanzee (F); S.O: superior oblique muscle.

The *triangularis* (text-fig. 25, *tri.*), although figured as a prominent muscle by Ruge (**42**), is represented by a few broad fibres passing from the platysma to the angle of the mouth.

The *orbicularis oris* is composed of fibres from all the facial muscles except the levator labii superioris alæque nasi; and it

has the usual sphincteric arrangement. From its deep surface it gives off small muscular slips (text-fig. 27) which are attached to the bones at the bases of the sockets of the incisor, canine and premolar teeth. These are best developed in the upper jaw. Between them and the mucous membrane there are numerous labial salivary glands and branches of the infra-orbital nerve plexus (text-fig. 26, I.O.P).

Between the levator labii superioris and the levator anguli oris numerous branches of the facial nerve and infra-orbital branches of the trigeminal nerve ramify and anastomose, and numerous labial salivary glands are present. The facial nerve supplies the muscles, and the infra-orbital nerves can be traced to both skin and mucous membrane.

The *levator anguli oris* (text-fig. 26, L.A.O) is a small triangular muscle. It arises from the maxilla below the infra-orbital foramen, and is inserted into the orbicularis oris at the angle of the mouth. A small slip passes to the skin of the upper lip. The latter is not mentioned by other authors.

The *buccinator* (text-fig. 26, Buc) arises from the maxilla and mandible close to the roots of the last molar teeth and from the pterygo-maxillary ligament. It emerges from under cover of the ascending ramus of the mandible and blends with the orbicularis oris in both lips; but the fibres do not decussate as in Man. Lying on its surface are a pad of fat, several buccal salivary glands, the buccinator branches of the internal maxillary artery, and the long buccal branch of the trigeminal nerve. It is crossed by the anterior facial vein and external maxillary artery.

Nasal Muscles (text-fig. 27 A):—No nasal cartilages exist *, so the nasal muscles are inserted into the skin. The upper border receives a continuous strip of muscles from the combined orbicularis oculi and frontalis and the levator labii superioris. The former corresponds to the pyramidalis (Pyr) and the latter to the levator labii superioris alæque nasi (L.A.N). Three small muscular slips arise from each half of the nasal orifice of the skull and are inserted into the deep surface of the skin. No depressor septi nasi is present. The sensory external nasal nerve is seen emerging from the nasal fossa on each side.

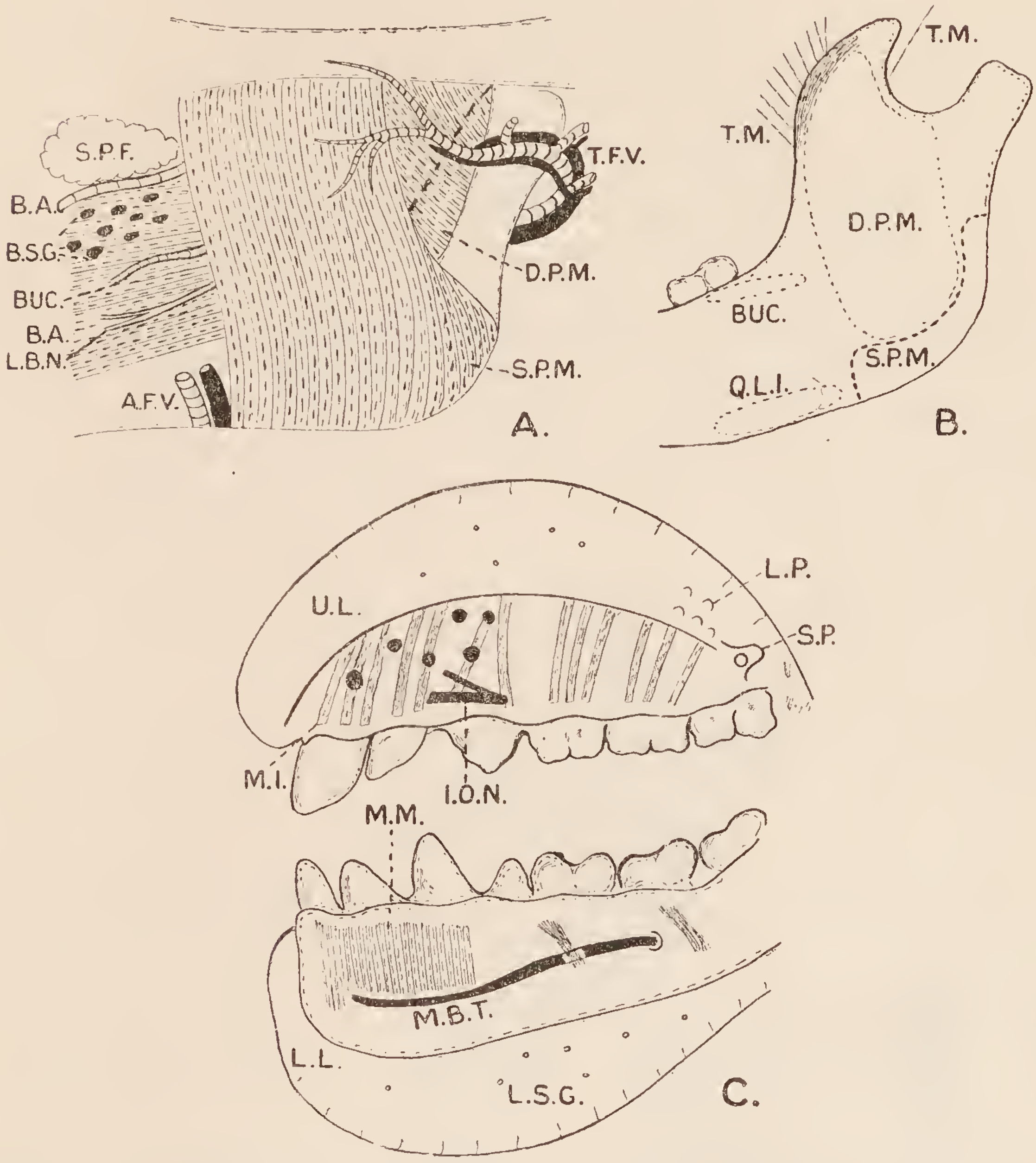
Extrinsic Muscles of the Auricle (text-fig. 25):—Ruge (**42**) described and figured a superior auricular muscle descending from the vertex of the skull to the root of the pinna, and auriculo-occipital and posterior auricular muscles acting on its posterior part. A small tragicus runs to the lower and front part of the pinna. Wilder (**53**) described an attolens and a combined attrahens and retrahens. In my specimen the attolens (Aur. Ant) arises from the epicranial aponeurosis, and the combined attrahens and retrahens (Aur. Post) arises from the aponeurosis and occipital crest, touching the occipitalis above. The fibres

* This statement is based on both macroscopic and microscopic examination. But future material may show that the conditions here are purely individual in character.

of both muscles are continuous on the root of the pinna. Slips from the platysma (Pla) go to the back of the auricle, and a small tragicus (Trag) is present.

The *masseter* (text-fig. 28 A) consists of the usual superficial and deep parts. The former (S.P.M) arises from the lower borders of the malar bone and anterior two-thirds of the zygoma;

Text-figure 28.



Muscles of mastication; A: Masseter; B: Attachments of muscles to the mandible; C: Muscles, nerves and vessels below the labial mucous membrane. B.A. and BUC: buccal artery and buccinator muscle; I.O.N., L.B.N., and M.B.T: infra-orbital, long buccal, and mental nerves; L.L. and U.L: lips; M.I. and M.M: incisive and mentalis muscles; L.P. and S.P: labial and salivary papillæ; S.P.F: suctorial pad of fat. Other letters as in text-fig. 26.

the fibres pass downwards and backwards to be inserted into the margin of the lower border, angle, and lower half of the posterior border of the ramus of the mandible. Between the two parts is a strong fascial sheet into which fibres of both parts are inserted. The deep part (D.P.M) arises from the entire length of the deep

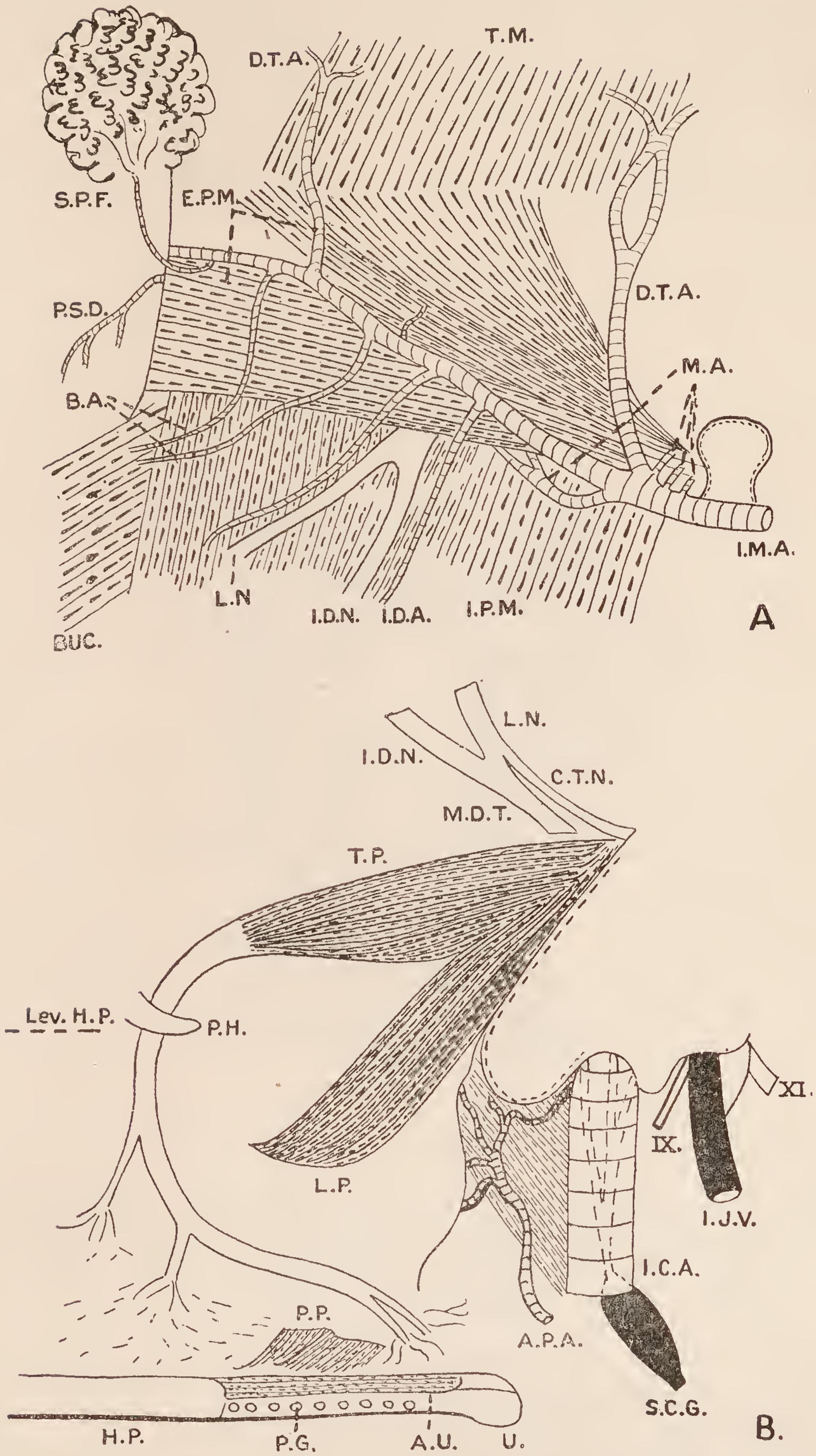
surface of the zygoma, and the fibres converge to be attached to the anterior two-thirds of the outer surface of the mandibular ramus and coronoid process. Numerous large vessels (T.F.V) ramify between the masseter and parotid gland and supply both. The actual insertions are shown in text-fig. 28 B.

The *temporal muscle* is large and powerful. It arises from the entire temporal fossa from the external angular process of the frontal bone in front, to about four centimetres behind the concha and upwards to a point level with the supra-orbital crest. It also arises from the temporal fascia which covers it. The fibres are strong, coarse and mixed with tendinous bands; they converge to be inserted into the anterior border, point and posterior border of the coronoid process (text-fig. 28 B). The anterior part of the muscle is attached by muscle fibres to the anterior border of the process, which is of considerable length. But the posterior part is attached by aponeurosis to the backwardly-directed point and short posterior border. On the surface of the muscle the zygomatico-facial artery ramifies. A piece of the aponeurotic insertion sweeps over the outer surface of the coronoid. The deep temporal vessels anastomose within it. The action of the temporal muscle is described at length by Gratiolet. The attachments of the masseter and temporal muscles to the mandibular ramus are shown in text-fig. 28 B. The *temporal fascia* is attached to the temporal crest, external angular process of the frontal bone, malar bone and upper border of the zygoma. It is overlain by a considerable deposit of fat. It gives an attachment to the fibres of the zygomaticus minor and extrinsic muscles of the auricle. A few fibres of the temporal muscle arise from it.

The *pterygoid muscles* (text-fig. 29 A) are very similar to those in Man, and all authors who have described them come to similar conclusions. The relations of the various nerves in the pterygoid region are the same as in Man, and the internal maxillary artery (I.M.A) crosses the outer surface of the external pterygoid (E.P.M) as in some human bodies. The veins, however, do not form a large diffuse plexus, but consist of tributaries accompanying the large arteries and opening into an internal maxillary vein. It divides into two veins which unite with the superficial temporal vein. It communicates with the anterior facial vein and with deep veins in the neck. No lymphatic glands are present in the pterygoid region, but much fat is present. It is, therefore, evident that, with the exception of the characters of the veins, the pterygoid region is essentially similar to that in Man.

The *sterno-mastoid* (text-fig. 30, S-M.M) arises by a long, gently tapering, strong tendon from the inferior border of the manubrium sterni, and it does not develop muscular fibres till it reaches the neck. A few small tendinous bundles run from the tendon of origin to the upper and mesial aspects of the sterno-clavicular articulation, and strong fascia unites the tendon to the

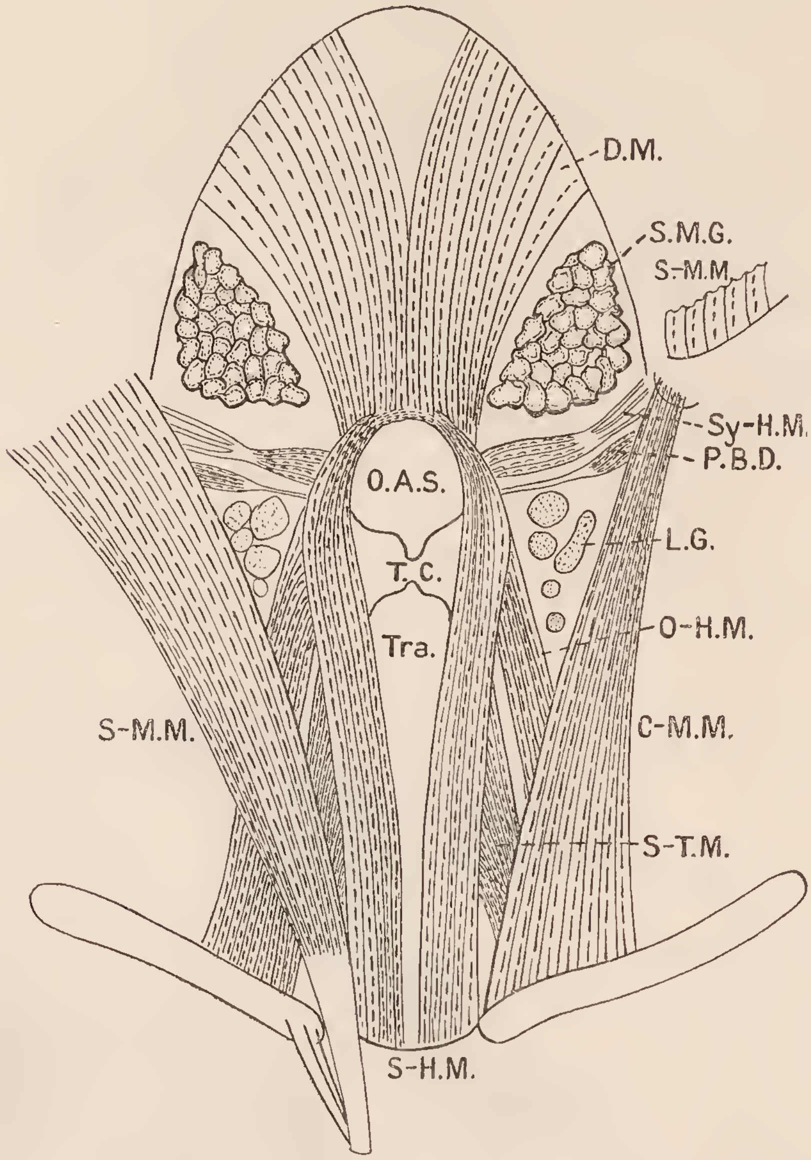
Text-figure 29.



Pterygoid (A) and Palatal (B) regions. E.P.M. and I.P.M: external and internal pterygoid muscles: A.P.A: ascending pharyngeal artery; I.M.A: internal maxillary artery (letters of branches on p. 384); I.C.A: internal carotid artery; I.D.N: inferior dental nerve; I.J.V: internal jugular vein; C.T.N: chorda tympani joining the mandibular nerve (M.D.T.); H.P: hard palate dropped for diagrammatic purposes below its true level (lev. H.P.); P.G: palatal glands; P.H: pterygoid hamulus; S.C.G: superior cervical sympathetic ganglion; IX. XI: cranial nerves.

inner end of the clavicle. It gives attachment to a few fibres of the pectoralis major, but it is not enveloped by the latter as described by Gratiolet and Alix (22). In the neck it forms a wide, comparatively thin muscle, whose fibres are coarse. It is inserted into the outer half of the superior curved line of the occipital bone, overlapping the trapezius. No fibres are attached to the mastoid process. Between the sterno-mastoid and subjacent cleido-mastoid there are muscular branches of the

Text-figure 30.



Muscles of the middle of the neck. L.G: lymphatic glands; O.A.S: opening into the air-sac from the ventricles of the larynx; O-H.M: omo-hyoid muscle; S.M.G: submaxillary gland; S-T.M: sterno-thyroid muscle; T.C: thyroid cartilage; Sy-H.M: stylo-hyoid muscle; Tra: trachea. Other letters in text.

occipital artery. The external jugular vein does not cross the surface of the muscle, and the transverse cervical nerve, after emerging from beneath the cleido-mastoid, runs forwards over the surface of the sterno-mastoid. The sterno- and cleido-mastoids are separate throughout, though closely apposed and surrounded by fascia.

The *cleido-mastoid* (text-fig. 30, C-M.M) arises from the inner third of the upper border of the clavicle. As it passes upwards

in the neck it becomes narrower and is inserted into the outer surface of the mastoid process. The muscle raises a prominent ridge on the anterior wall of the air-sac. Many vessels and nerves pierce the deep fascia at the lateral border of the cleido-mastoid; and the spinal accessory nerve passes into its deep surface in the upper third.

When an incision is made through the platysma and deep fascia the wall of the air-sac makes its appearance. The wall varies in thickness in different parts, and its lining is smooth and moist. It consists of a central part with two lateral diverticula. The central part extends upwards to the hyoid bone, and downwards to the lower border of the manubrium sterni between the tendons of origin of the sterno-mastoid muscles. Its anterior wall is covered by the platysma, and the larynx, trachea and pre-tracheal muscles shine through the thin posterior wall. The lateral parts are very capacious, and have large circular orifices under cover of the cleido-mastoids. When these are explored the finger can pass along the greater part of the deep surface of the pectoral muscles and the inner border of the deltoid; it palpates the entire length of the clavicle, the head of the humerus, the glenoid cavity, and borders of the scapula. Many muscles, nerves, and the carotid sheath form ridges in the walls of the sac.

The *omo-hyoid* (text-fig. 32 A) is more complex than in Man, and it is more complex in my specimen than in others described. It consists of three bellies. The postero-mesial belly is tapering. It arises from the back of the first costal cartilage along with the sterno-thyroid muscle, with which it is considerably fused. The anterior belly is tapering, and inserted into the lower border of the hyoid bone at the side of sterno-hyoid. The postero-lateral belly, which is the strongest, arises from the upper border of the scapula close to the root of the coracoid process. All three bellies meet in a Y-shaped junction, and a tendinous thread runs into sterno-hyoid.

The *sterno-hyoid* (text-fig. 30, S-H.M) arises from the back of the upper part of the manubrium sterni, and is inserted into the lower border of the hyoid bone. The opposite muscles first diverge and then converge, and fibres pass between them on the hyoid bone. The *sterno-thyroid* arises from the back of the manubrium sterni and first costal cartilage and is inserted into the upper part of the thyroid ala. Some fibres pass into the thyro-hyoid muscle.

The *digastric muscle* (text-fig. 30, D.M) is transitional between Parson's first and third types. The anterior bellies are only separate in front. They are fused behind where they arise from the front of the body of the hyoid bone. Each belly is inserted into the anterior two inches of each half of the mandible. The posterior belly is bulky, but the tendon (text-fig. 30, P.B.D), which enters the postero-lateral part of the anterior belly immediately in front of the hyoid bone is long and slender. It arises from

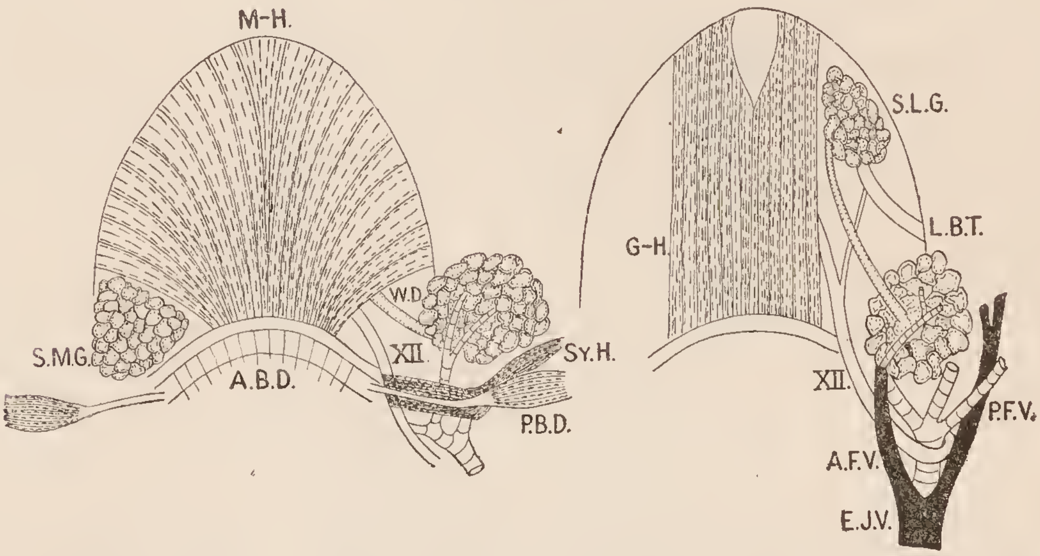
the depression on the temporal bone corresponding to the digastric fossa in Man. Chaîne (10) has recently described the digastric muscle. The tendon of the posterior belly tunnels the stylo-hyoid muscle; it has no direct attachment to the hyoid bone as described by Gratiolet (22).

Some fibres of omo-hyoid and sterno-hyoid pass into the anterior bellies of the digastrics.

The *stylo-hyoid* arises by one large and several small tendons from the styloid process and bone around. It is long, thin, fleshy, and wrapped round the digastric tendon. It is inserted into the upper border of the hyoid bone opposite sterno-hyoid and omo-hyoid.

The *mylo-hyoid* (text-fig. 31, M-H) arises from the upper border of the hyoid bone under cover of, but never fused with,

Text-figure 31.



Anatomy of the submental region (No. 1). A.B.D: anterior belly of the digastric turned down; A.F.V: anterior facial vein; E.J.V: external jugular vein; L.B.T: lingual nerve; P.B.D: posterior belly of the digastric; P.F.V: posterior facial vein; S.M.G: submaxillary gland; Sy.H: stylo-hyoid muscle; W.D: Wharton's duct. Other letters in text.

the anterior belly of the digastric. The level of origin corresponds to the extent of the insertions of the sterno-hyoid and omo-hyoid on the posterior border. The fibres radiate to be inserted into the inner surface of the mandible. The posterior fibres lie just in front of the submaxillary gland. Lying on the surface of the muscle and supplying it are branches of the submaxillary twigs of the external maxillary artery. I did not observe any decussation of fibres in the middle line as described by Gratiolet (22).

No submental lymphatic glands were found behind the symphysis menti.

The *genio-hyoid muscles* (text-fig. 31, G-H) are separated anteriorly close to their origins from the lower part of the genial fossa on the back of the symphysis menti. In the greater part of

the interramal space the two muscles are in contact in the mid line. They are inserted into the upper border of the body and part of the great cornu of the hyoid bone. At their sides lie deposits of fat surrounding the sublingual glands (S.L.G), the numerous arteries to these glands, and the large lingual branch of the trigeminal nerve (L.B.T). The latter is seen vanishing under cover of the genio-hyoid muscle. The hypoglossal nerve (XII) also is seen dividing into branches which pass under the muscles and sublingual glands. When the genio-hyoidei are reflected it is seen that a well-marked bursa, capable of lodging the tip of the index finger, lies between them and the hyoid bone anteriorly and the genio-glossi posteriorly; and there is a thick fatty septum between the two genio-glossi. The hyo-glossi crossed antero-posteriorly by the strong, thick, stylo-glossi; the sublingual glands and the hypoglossal and lingual nerves are further displayed. The former is seen giving two branches to its corresponding genio-hyoid.

The *genio-glossi* (text-fig. 32, G.G) are two long, narrow, thick muscles arising from the bottom of the genial fossa. They are separated in the mid line by a comparatively thick deposit of fat, and a considerable interval separates each from the mandible. In that space the entire sublingual gland, the hyoglossus and styloglossus muscles, the lingual and hypoglossal nerves and the lingual artery are seen. The artery emerges from under the hyo-glossus. Some fibres of the genio-glossi reach the hyoid bone under the hyo-glossus.

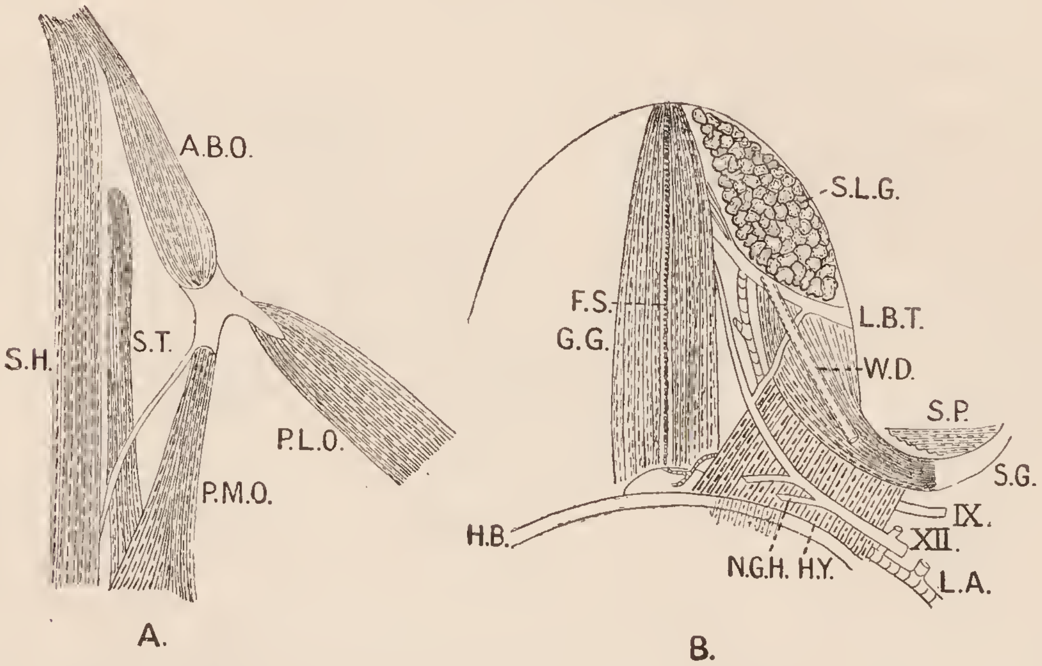
The *hyo-glossus* (text-fig. 32, HY) arises from the lateral part of the body and the whole of the great cornu of the hyoid bone, but the origin from the body does not spread over a half as stated by Gratiolet (22). The fibres pass upwards to be inserted into the side of the posterior half of the tongue under the stylo-glossus. It is not fused with the opposite muscle, but fibres of the thyro-hyoid can be traced into it. A great part is concealed by the stylo-glossus. The relations are very similar to those in Man.

The *stylo-glossus* (text-fig. 32, S.G) is relatively more powerful than that in Man. It arises by a short, rounded strong tendon from the outer surface of the base of the styloid process. It describes a curve as in Man, and its volume increases greatly as it is traced forwards. It gains an attachment to the side of the tongue from the level of the outer border of the hyo-glossus behind to nearly the apex of the tongue in front. It covers the upper half of the hyo-glossus, and it extends from the side of the tongue above to the outer border of the genio-glossus below. The part anterior to hyo-glossus is concealed by the large sublingual gland, with the lingual branch of the trigeminal nerve curving round its posterior pole. The connecting loop between the lingual and hypo-glossal nerves crosses it anteriorly, and Wharton's duct (W.D) crosses it obliquely from above downwards and behind forwards.

The *superior constrictor of the pharynx* is continuous above and

in front with the buccinator, both being attached to the pterygo-mandibular ligament. It is attached to the mylo-hyoid line on the mandible, the internal pterygoid plate, the base of the tongue, the mucous membrane of the floor of the mouth and the bucco-pharyngeal aponeurosis. The lower border is overlapped by the middle constrictor, and the stylo-pharyngeus passes between them as a few separate, but thick, bundles of fibres. Some of these fibres pass into, and blend with, the outer surface of the superior constrictor. The upper part of the muscle is separated by a large sinus of Morgagni from the base of the skull, but the levator palati and tensor palati, which are situated therein, lie horizontally, whereas they are more vertical in Man, and of smaller size. The constrictor is attached above and behind into

Text-figure 32.



The omo-hyoid muscle (A) and the anatomy of the submental region (B). A.B.O., P.L.O., and P.M.O: anterior, postero-lateral and postero-mesial bellies of the omo-hyoid muscle; F.S: fatty septum; L.A: lingual artery; N.G.H: nerves to the genio-hyoid muscle; H.B: hyoid bone; S.H. and S.T: sterno-hyoid and sterno-thyroid muscles; IX and XII: cranial nerves. Other letters as in text-fig. 31.

the basis cranii. It is difficult, and in some places impossible, to separate the superior constrictor from the stylo-glossus muscle which courses downwards and forwards on its outer surface.

A well-marked bundle of fibres passes towards the angle of the mouth. The *middle constrictor of the pharynx* arises from the deep surface of the hyoid bone in the angle between the greater and lesser cornua, and it is inserted into the mid-dorsal line of the pharynx, its fibres mingling with those of the opposite muscle. It is overlapped by the inferior constrictor. Some fibres of the stylo-pharyngeus pass into its outer surface. Between the superior and middle constrictors there is a non-muscular area anteriorly. The *inferior constrictor of the pharynx* arises as in

Man from the oblique line on the thyroid cartilage and from the side of the cricoid. Its fibres sweep more or less upwards, overlap the lower border of the middle constrictor and blend with the opposite muscle in the mid-dorsal line. It has no origin from the first tracheal ring as in Gratiolet's specimen (22).

The *stylo-pharyngeus* (text-fig. 32, S.P) arises from the tendon of the stylo-glossus, but Gratiolet (22) states that it rises from the base of the styloid apophysis. It splits up into bundles some of which are inserted into the superior and middle constrictors, others passing between these muscles and radiating in the wall of the pharynx. The glosso-pharyngeal nerve hooks round it and sends it a well-marked branch.

The *levator palati* and *tensor palati* (text-fig. 29 B) arise by a strong, common musculo-aponeurotic origin from the apex of the petrous temporal bone, the under surface of the Eustachian tube and the scaphoid fossa. So the separate origins of the muscles have fused in this animal. The *levator palati* (L.P) runs downwards and forwards and spreads out between the layers of the palato-pharyngeus. The *tensor palati* (T.P) is even more horizontal. Its tendon winds round the pterygoid hamulus and is inserted by several small tendinous and fascial bundles in the palatal aponeurosis. The complete limits of the *palato-pharyngeus* (P.P) could not be accurately made out, and the *palato-glossus* hardly exists. The *azygos uvulæ* (A.U) ends posteriorly in membrane as pointed out by Gratiolet (22).

The *thyro-hyoid* runs from the entire width of the thyroid ala to the under and outer surfaces of the body and great cornu of the hyoid bone. Its nerve from the hypoglossal is well marked.

The *scalenus anticus* arises from the anterior tubercles of the transverse processes of the third, fourth, and fifth cervical vertebræ, but others have given its origin from 4, 5, and 6. It is connected by a tendon to the rectus capitis anticus major. It is inserted as in Man, the tubercle on the first rib being lateral to the chondro-costal junction. The *scalenus medius* and *scalenus posticus* arise as in Man. They unite to form a flat sheet which courses downwards to be attached to the outer surfaces of the first five ribs. The fusion and extent are greater than that described by Gratiolet (22) and others. It is crossed posteriorly by the slips of insertion of the upward continuation of the sacro-spinalis.

The *omo-trachelian* runs as usual from the transverse process of the atlas to the upper and outer aspect of the acromion. It has been recorded by some as being not an omo-trachelian, but as an acromio-basilaris.

Muscles and Fasciæ of the Back.

The fascia covering the trapezius and latissimus dorsi is of great strength, especially below. It is attached above to the occipital crest, mesially to the vertebral spines and below to the

iliac crest. It is continuous with the fascia over the gluteal muscles. Laterally it is continuous with deep fascia of the neck, thorax and limbs.

The *trapezius* arises from the inner third of the occipital crest, the external occipital protuberance, all cervical spines, the thirteen dorsal spines and the supraspinous ligament. There is no ligamentum nuchæ, so the origin differs from that in Man. Various authors have recorded it as arising from the first ten or twelve dorsal spines. The lower border is not fused with the latissimus dorsi, as described by Champneys (**11**), Bland Sutton (**4**), and others, though some anatomists did observe fusion. Close to the lower angle of the scapula there is a triangle of auscultation similar to that in Man. The whole origin is muscular, there being no aponeurosis close to the vertebral spines as there is in Man. It is inserted into the outer third of the posterior border of the clavicle, some fibres passing into the deltoid, the outer border of the acromion and the whole length of the spine of the scapula. The most lateral part of the spinous insertion is aponeurotic. There is no differentiation of fibres inserted into a special area on the root of the spine of the scapula as there is in Man. The spinal accessory nerve can be traced almost to the lower border of the muscle, and gives off numerous branches to it. It communicates with the third and fourth cervical nerves, but there is no marked sub-trapezial nerve plexus. It divides at the root of the neck into two marked branches. One of these goes to the cervical part of the trapezius and the other to the thoracic part.

The *latissimus dorsi* arises from the lower five dorsal spines and supraspinous ligaments, the posterior lamella of the lumbo-dorsal fascia and the posterior lip of the iliac crest from the highest point to the anterior superior spine, where it overlaps the outer border of the external oblique. It also receives slips from the ninth, tenth and eleventh ribs, but none from the inferior angle of the scapula. On the ribs, whence it derives slips, it fuses with the origin of the external oblique. The strong tendon is inserted into the floor of the bicipital groove on the humerus, and is extensively fused with the teres major and dorso-epitrochlearis. No band runs across the axillary vessels. Bland-Sutton (**4**) emphasises the absence of the latter slip. Champneys (**11**) gives the costal origin as ribs 10–13, and mentions a lesser adhesion to the teres major. Hepburn (**24**) gives its origin from the anterior half of the outer lip of the iliac crest, and records three costal slips; he also mentions slight fusion with the teres major.

The *rhomboideus* is an undivided sheet arising from the last two cervical and first four dorsal spines. It is inserted into the lower three-fourths of the vertebral border of the scapula. The insertion reaches higher than the root of the spine of the scapula, and its upper part overlaps the insertion of the levator anguli scapulæ. Gratiolet (**22**) described the origin as extending from

the occiput to the seventh dorsal spine. The sheet is undivided into major and minor muscles, in which it agrees with that described by Gratiolet (22), Vrolik (**51**), Macalister (**33**), Bland-Sutton (**4**), and Wilder (**53**). Champneys (22) describes major and minor rhomboids in great detail.

The *levator anguli scapulæ* (text-fig. 33, L.A.S) arises by five slips from the posterior tubercles of the first five cervical vertebræ, the first being the largest. The lower three origins are tendinous and fused with splenius cervicis. It is inserted into the upper fourth of the vertebral border of the scapula. It is not adherent to serratus magnus, nor is it divisible into two parts. Champneys (**11**) gives the origin as the first two cervical vertebræ; Gratiolet (22) gives it as the second and third; Hepburn (24) records origins from three cervical vertebræ; Wilder (**53**) gives it as in Man, and Bland-Sutton (**4**) records it as springing from the first five.

The *serratus posticus superior* (text-fig. 33, S.P.S) arises by a thin aponeurosis from the spinous processes of the seventh cervical and first dorsal vertebræ, and it is inserted by four muscular slips into the outer surfaces of the first four ribs at their angles. Macalister (**33**) describes it crossing the first two ribs to be attached to the third and fourth. The *serratus posticus inferior* arises from the posterior lamella of the lumbo-dorsal fascia and sweeps antero-laterally to be inserted into the lower borders of ribs nine to thirteen just external to their angles. Bland-Sutton (**4**) gives its attachments as ribs nine to twelve.

The *lumbo-dorsal fascia* is arranged as in Man. The thoracic part is thin and transparent, and it is difficult to separate it off from the subjacent muscles as a continuous sheet. The lumbar part is very dense and strong. The posterior lamella is not easily separated from the latissimus dorsi, to which it gives origin. Posterior branches of the spinal nerves pass through its deep surface. In its lower part it gives origin to the serratus posticus inferior. Between the outer and middle lamellæ the erector spinæ is present, and the attachments of the middle lamella are as in Man. The quadratus lumborum lies between the moderately strong middle lamella and the weaker internal lamella, whose attachments to the arcuate ligaments of the diaphragm are as in Man.

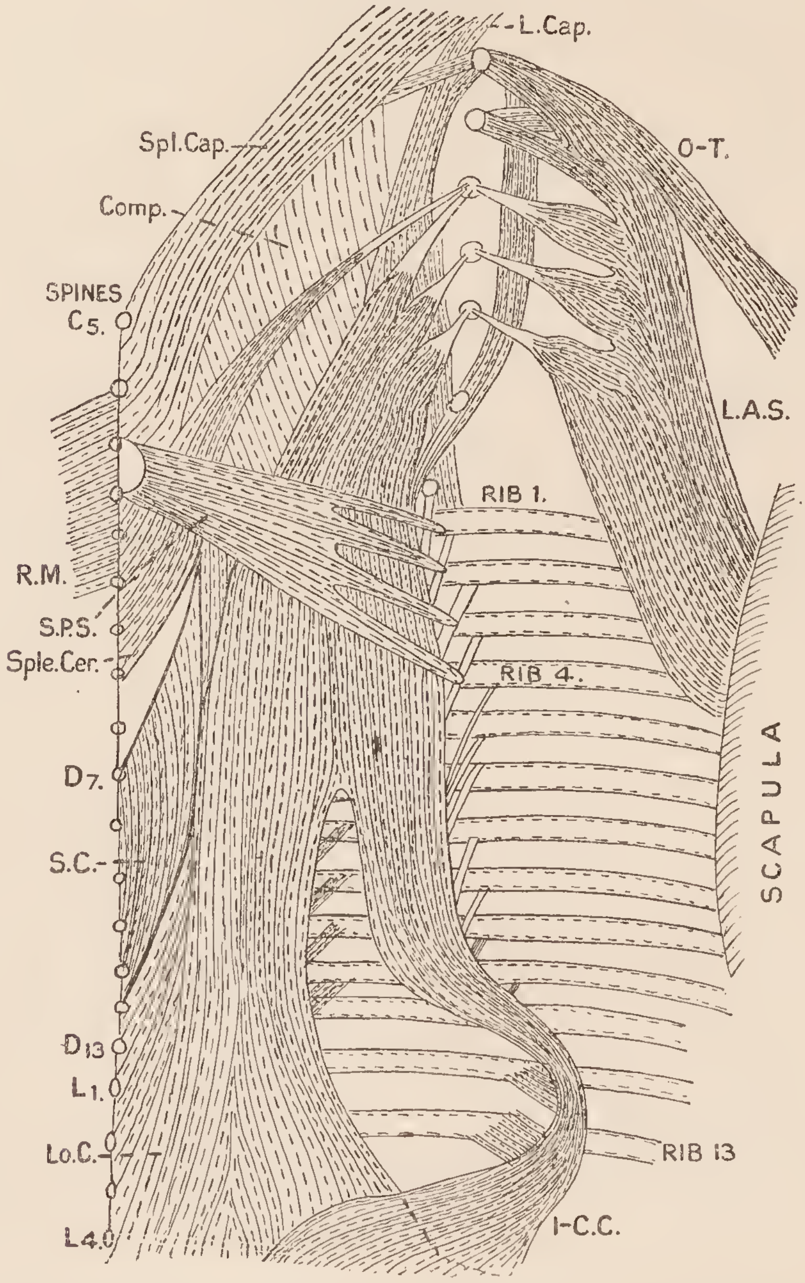
In the possession of a serratus posticus inferior the Chimpanzee resembles Man, and that muscle is one of the three characteristically human muscles. It will be seen later that the Chimpanzee possesses the plantaris, which is the second human muscle, but it does not possess the peroneus tertius.

The muscles of the back described above are relatively stronger than in Man, and they are relatively weaker than the pectorales, but the total bulk of these groups has probably diminished during captivity.

The *splenius* (text-fig. 33) arises from the sides of the tips of the fifth, sixth, and seventh cervical vertebræ, and from the spines

of the first seven dorsal vertebræ. All the origin is muscular except that from the sixth and seventh cervical vertebræ. The greater part becomes splenius capitis (Spl.Cap.) which is inserted into the mastoid and outer part of the superior curved line of the occipital bone, and a small slip runs into the first head of the levator scapulæ. The splenius cervicis (Sple. Cer.) consists of one digitation which joins the third head of the levator scapulæ.

Text-figure 33.



Muscles of the back. Comp: complexus; R.M: rhomboideus. Other letters in text.

Other observers give the splenius cervicis insertions into the first four cervical vertebræ.

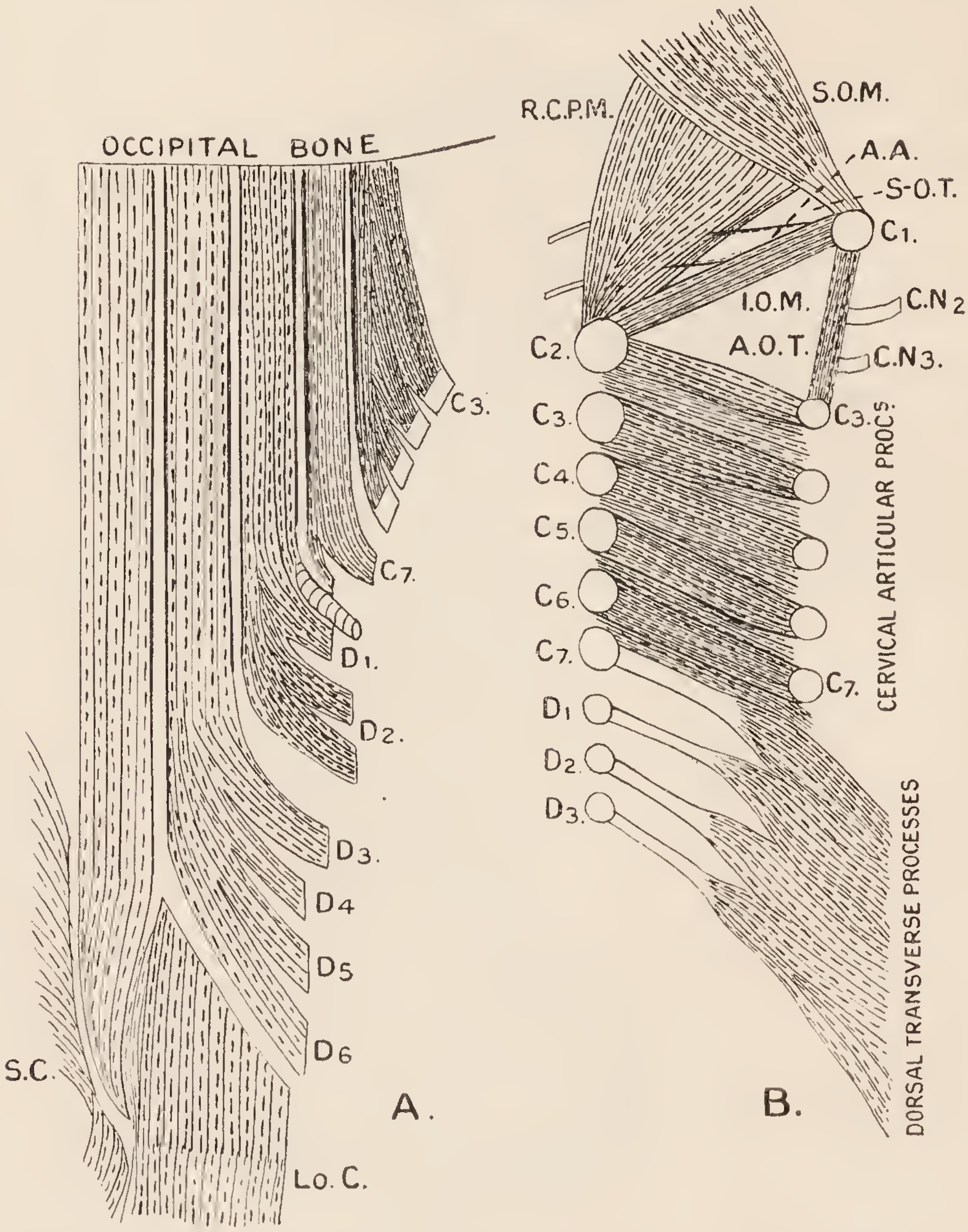
The *sacro-spinalis* (erector spinæ) is divisible into three columns —an outer ilio-costalis, a middle longissimus, and an internal spinalis—but their characters differ from those of the corresponding muscles in Man. The outer and middle columns are intimately fused at the origin of the muscle; they separate in the lumbar and greater part of the thoracic region; in the upper

thoracic and lower cervical regions they are fused; and the combined mass eventually breaks up again into muscular slips. The inner column separates off in the upper thoracic region. The *ilio-costalis* (text-fig. 33, I-C.C) arises with the subjacent longissimus from the iliac crest between the highest point and the posterior superior spine, and it derives fibres from the covering posterior lamella of the lumbo-dorsal fascia. It gives two slips to the lower borders of the twelfth and thirteenth ribs, of which the former is the larger. It receives a large number of muscular slips from the outer surfaces of all the ribs, the size of the latter diminishing from below upwards. Many of the small muscular slips are continuous with the slips given off from the longissimus. From the outer border of the muscle long, slender tendons run to the lower borders of the angles of the first nine ribs. The *longissimus* (text-fig. 33, Lo.C) arises from the crest of the ilium from the highest point to the posterior superior spine, the posterior sacro-iliac ligament, the back of the sacrum, all sacral and lumbar vertebral spines and the spines of the twelfth and thirteenth dorsal vertebræ. It gives slips to the lower borders of ribs 4 to 13 between their angles and the transverse processes. The attachments to the first three ribs come from the combined longissimus and ilio-costalis. The combined outer and middle columns divide into slips which are attached to the posterior tubercles of the transverse processes of the third, fourth, and fifth cervical vertebræ along with the levator angulæ scapulæ. The third cervical vertebra thus receives splenius cervicis, levator anguli scapulæ and longissimus. The part of longissimus attached to these processes corresponds to longissimus cervicis in Man, but is not so extensive. The *spinalis dorsi* (text-fig. 33, S.C) is a narrow muscle arising from the longissimus dorsi and the eleventh and twelfth dorsal spines. It is inserted by muscular and tendinous fibres into the first eight dorsal spines. Between it and the longissimus is a triangular space into which the complexus passes and fuses with both. The *longissimus capitis* (text-fig. 33, L.Cap) is relatively stronger than in Man. It arises from the first six dorsal transverse processes by tendinous and muscular slips. It is fused with the longissimus dorsi, complexus and scalenus posticus. It breaks up into slips which are inserted into the posterior tubercle of the atlas and the occipital bone below the crest. On the atlas its insertion is fused with the levator scapulæ and omo-trachelian.

The *complexus* (text-fig. 34 A), lying under the longissimus capitis, has a very extensive origin from the articular processes of the lower five cervical vertebræ, the upper six dorsal transverse processes and the longissimus and spinalis dorsi. It forms a number of closely-set parallel muscle bundles which are inserted into the inner half of the occipital bone below the superior curved line. It is not separable into a biventer cervicis and complexus as in Man. No slip springs from the seventh cervical spine.

The *semispinalis* (text-fig. 34 B) has an origin from the articular processes of the lower five cervical vertebræ by broad bands, and from the transverse processes of all dorsal vertebræ, the lower five origins being tendinous. It is inserted into the spinous processes of cervical vertebræ two to six by muscle fibres (semispinalis colli) and to the seventh cervical and first three dorsal spines by tendons (semispinalis dorsi). It is practically

Text-figure 34.



Muscles of the back. A: complexus; B: semispinalis and suboccipital muscles. A.A: posterior arch of atlas; $C.N_2$ and $C.N_3$: posterior divisions of the second and third cervical nerves; Lo.C: longus colli; S.C: spinalis; S.O.T: suboccipital triangle. Other letters in text.

impossible to distinguish accurately the limits between these muscles in the combined origins.

A well-marked muscular slip runs from the third articular process to the transverse process of the atlas and forms a triangle with the inferior oblique and semispinalis (text-fig. 34, A.O.T). It alters the course of the second and third cervical nerves. The mass of the transverse process of the atlas separates it from the

origin of the rectus capitis lateralis, and the latter is the only muscle whose fibres run in the same direction *.

The *multifidus spinæ* extends from the sacrum to the axis. It arises from the sacrum, sacro-iliac ligament, mammillary processes of the lumbar vertebræ, transverse processes of all dorsal vertebræ, and lower four cervical articular processes. It is inserted into the spines of all vertebræ except the atlas. The semispinalis covers it but its fibres, which run in the same direction, are longer than those of the multifidus, and extend to vertebræ farther apart. The cervical fibres of the multifidus do not form broad bands.

The *obliquus inferior* (I.O.M) and *obliquus superior* (S.O.M) (text-fig. 34 B) are as in Man.

The *rectus capitis posticus major* (text-fig. 34, R.C.P.M) is a powerful pyramidal muscle quite concealing the minor muscle. It arises from the spinous process of the axis and is inserted into the occiput below the entire length of the superior oblique. The *rectus capitis posticus minor* arises from the inner three-quarters of an inch of the posterior arch of the atlas and is inserted into the occipital bone below the major muscle. It is quite concealed by the latter, and by the approximation of the walls of the sub-occipital triangle. *Rectus capitis lateralis* is as in Man.

Interspinales, intertransversarii and levatores costarum are as in Man. Rotatores dorsi are twelve pairs of fan-shaped muscles running from the transverse processes of the dorsal vertebræ to the laminæ of the vertebræ above them, the first one being inserted into the seventh cervical lamina.

Muscles of the Thoracic Parietes.

The *external intercostal muscles* run in the same direction as those in Man. They extend from the angles of the ribs to the sternum in the first three and last two spaces. But there are external intercostal membranes in the other spaces. The *internal intercostals* do not differ materially from those in Man. The *triangularis sterni* arises as in Man from the back of the ensiform cartilage, and it is inserted by radiating slips into the sternal ends of the second, third, fourth, fifth, and sixth ribs. It has a slightly different relation to the internal mammary artery from that in Man, the details being given with that vessel on page 386.

The *sternalis* muscle is absent. Some authors describe it, and their observations have been collected by Keith (29).

Contrary to the conditions in Man, there is a well-marked lateral branch of the first intercostal nerve. It runs over the pectoralis major and fades away among the glands in the axilla.

Prevertebral Muscles.

The *longus colli* consists, as in Man, of vertical, superior, oblique and inferior oblique portions. The vertical part arises from the

* This is probably an individual peculiarity.

lower two cervical and upper four dorsal vertebræ, and is inserted into the bodies of the second, third, and fourth cervical vertebræ. The lower oblique portion runs from the first four thoracic to the fifth and sixth cervical vertebræ. And the upper oblique part runs from the third, fourth, and fifth cervical vertebræ to the anterior arch of the atlas. The *rectus capitis anticus major* runs from the third, fourth, fifth, and sixth cervical vertebræ to the basi-occiput. It receives a well-marked slip from the scalenus anticus. The *rectus capitis anticus minor* and *rectus capitis lateralis* are as in Man.

It is, therefore, evident that the facial muscles, the muscles of the back, the scaleni, and the prevertebral muscles are relatively stronger and more intimately united than in Man. This must necessarily make the muscular movements less numerous and not so fine as in him. The muscles forming the suboccipital triangle are crushed together.

Muscles of the Pectoral Extremity.

The *pectoralis major*, which is less powerful than in Man, consists of clavicular, costo-sternal, and abdominal parts. The clavicular part consists of superficial and deep portions. The former arises from the inner half of the front of the clavicle and the outer side of the tendon of the sterno-mastoid; the latter springs from the inner part of the lower surface of the clavicle and fuses with the former, and with the deep surface of the costo-sternal part. The costo-sternal portion arises from the whole length of the body of the sternum and the first six costal cartilages; it fuses with both the external oblique and the abdominal part of the pectoralis major at the lower borders of the fifth and sixth costal cartilages. The abdominal part fuses with the external oblique as far as the linea semilunaris; it also gets origins from the lower borders of the fifth, sixth, and seventh costal cartilages. The abdominal portion joins the deep surface of the sternal portion to form a muscle which joins the deep surface of the clavicular part. The combined muscle has a musculo-aponeurotic insertion into the inner border of the pectoral crest, the lower part of the capsule of the shoulder joint and the deep fascia of the arm. It is never fused with the deltoid.

I agree with Champneys (**11**) and Macalister (**33**) that there is no actual separation between the clavicular and costo-sternal parts such as occurs in Man. Champneys records a special slip arising from the fourth and fifth cartilages, but that is not the case in my specimen.

The delto-pectoral triangle contains the external anterior thoracic nerve, thoracic axis vessels, and tendon of the pectoralis minor. It has no lymphatic glands nor the cephalic vein, which are present in Man. Bland-Sutton (**4**) states that the groove between the pectoralis major and deltoid is absent.

The *pectoralis minor* appears to vary considerably both in origin and insertion. In my specimen it arises by three well-marked slips from the lower borders of the second, third, and fourth costal cartilages. Its long, but strong, tendon passes through a fibrous and synovial sheath over the coracoid process, and it is inserted into the upper and back part of the capsule of the shoulder joint. The sheath is adherent to the inner and upper parts of the coracoid process. Champneys (**11**) gives its origin from the first four ribs and its insertion into the capsule of the shoulder joint close to the supra-spinatus tendon, and Humphry (**26**) mentions it as extending across to the great tuberosity of the humerus. Bland-Sutton (**4**) describes an insertion similar to that in my specimen, but gives its origin as ribs three, four, and five. Wilder (**53**) and Gratiolet (**22**) record tendons inserted into both the coracoid process and capsule of the shoulder joint, and the latter gives the origin as ribs two to five inclusive. So if several animals are examined the muscle appears to write its evolutionary history.

The *serratus magnus* arises by eleven digitations from the first eleven ribs, the first one being very small, but it has a remarkably rich supply of nerves (text-fig. 48). The first nine arise from the outer surfaces of the ribs, but the tenth and eleventh arise from the lower borders. The digitations arising from the fifth to the eleventh ribs interdigitate with the external oblique. The muscle is thick at its insertion into the deep aspect of the vertebral border of the scapula. The part arising from the first four ribs is much thinner than the remaining part of the muscle. Champneys (**11**) has given the origin as from the first ten ribs, and described the muscle as consisting of three parts, which he describes in great detail, but Wilder (**53**) describes two parts, and gives the origin from all the ribs.

The *subclavius* arises from the upper border of the first costal cartilage immediately internal to the rib. It is inserted into the under surface of the second quarter of the clavicle from the inner end. It is enveloped as in Man by the costo-coracoid membrane.

The *costo-coracoid membrane* is attached to the first costal cartilage round the tendon of origin of the subclavius, to the inferior surface of the sterno-clavicular joint, to the under surface of the clavicle by two layers which enclose subclavius as in Man, and to the anterior surface of the clavicle lateral to the subclavius. The costo-coracoid ligament is well marked. Several authors have recorded the latter. The clavi-pectoral fascia extending downwards from the costo-coracoid ligament splits to enclose the pectoralis minor, and at the same time it sends a process inwards to the neuro-muscular bundle in the axilla. External to the pectoralis minor the fascia passes to the deep fascia of the axilla, and it passes mesially to the deep fascia covering the serratus magnus between the pectoralis major and latissimus dorsi. The membrane is pierced by the external

anterior thoracic nerve and the thoracico-acromial vessels, but it is not pierced by the cephalic vein which runs through it in Man and many other mammals. The fibres run transversely below the costo-coracoid ligament.

The *deltoid*, covered by dense fascia, is coarsely fasciculate. It arises from the front of the outer half of the clavicle and the outer border of the acromion process. A second part has an extensive aponeurotic and fascial origin from the whole length of the lower border of the spine of the scapula, and from the fascia over the entire infra-spinatus. At the inferior angle of the scapula the fascial origin blends with serratus magnus, the rhomboids, teres major, and latissimus dorsi. It conceals a bursa which intervenes between the acromion and upper end of the humerus, but does not communicate with the shoulder joint. One large and several small branches of the circumflex nerve, and branches of the circumflex arteries are seen entering its deep aspect. Humphry found it adherent to the brachialis anticus (**26**), but Macalister (**33**) denied that it adheres to the triceps and brachialis anticus. Wilder (**53**) points out that the attachment to the fascia over the infra-spinatus and the axillary border of the scapula enables the animal to swing the arm far back. The muscle fibres all converge to be inserted into the usual deltoid area on the shaft of the humerus. The insertion is embraced by the brachialis anticus.

Scapular Muscles:—All observers are agreed that the infra-spinatus greatly exceeds the supra-spinatus in size, and both arise from the whole of the scapular fossæ to which they are attached. They are inserted as in Man into impressions on the great tuberosity. Corresponding vessels and nerves pass into them as in Man. The infra-spinous fossa is deep, being enclosed between the prominent spine and a thickening of the axillary border of the scapula. The *teres minor* arises from the lower border of the lip of the glenoid cavity and lateral half of the axillary border of the scapula. It is inserted into the lowest part of the great tuberosity of the humerus and the upper half inch of the shaft of the bone. Champneys (**11**) gives its origin as the mid third of the axillary border and the adjacent part of the infra-spinous fossa, and Hepburn (**24**) records its origin from the upper two-thirds of the axillary border. The *teres major* arises from the medial half of the axillary border of the scapula, and is inserted into the inner lip of the bicipital groove. It is strongly fused with the latissimus dorsi. The *subscapularis* arises from the whole of the subscapular fossa, and tendinous bands run through between the bundles of fibres to the bone. It has no origin from fascia over it. The muscular mass converges, and is inserted by three tendons into the lesser tuberosity and the shaft of the humerus over a quarter of an inch below it. Some of the deep fibres are directly inserted into the capsule of the shoulder joint.

The *coraco-brachialis* is fleshy throughout. It arises along with the short head of the biceps from the tip of the coracoid

process, and it is inserted into an impression over an inch long on the inner aspect of the shaft of the humerus. In its upper part it is separated by a cellular interval into two parts, and the musculo-cutaneous nerve passes through the gap. No coraco-brachialis brevis was present. Some fibres go to the internal intermuscular septum and dorso-epitrochlearis, and Hepburn (**24**) suggests that these represent the coraco-brachialis longus. The part running to the inner surface of the shaft of the humerus corresponds to the coraco-brachialis medius. No coraco-brachialis brevis was recorded by Champneys (**11**), Bland-Sutton (**4**), Dwight (**18**), and Wilder (**53**), but it was seen by Macalister (**33**) and Hepburn (**24**). Bland-Sutton gives its insertion into the upper third of the shaft of the humerus and the capsular ligament. Wilder states that it arises from the coracoid process through the medium of the short head of biceps.

The *biceps* arises as in Man, but the bellies remain separate till they reach the junction of the lower and middle thirds of the arm. In the upper part of the forearm there is a slight bicipital fascia (lacertus fibrosus). The muscle fibres of the combined bellies end in a stout, ribbon-like tendon which is inserted into the posterior part of the radial tuberosity.

The *brachialis anticus* is connected by a strong fascial band to the pectoralis major near its insertion. The origin is as in Man and embraces the insertion of the deltoid. A slip is given to the fascia of the forearm. The fibres converge to an insertion into the coronoid process and inner border of the olecranon.

The *dorso-epitrochlearis* is a thin muscle, a little more than half an inch wide, springing from the junction of the muscular and tendinous parts of the latissimus dorsi. Fibres pass into its upper part from the coraco-brachialis. It passes into the inner side of the internal intermuscular septum in the lower third of the arm, and the latter connects it to the internal condyle.

The *triceps* differs considerably from that in Man. The long head arises from the dorsal aspect of the outer quarter of the axillary border of the scapula. The outer head arises from the upper extremity of the shaft of the humerus and lower part of the capsule of the shoulder joint. The inner head arises from the proximal third of the shaft of the humerus along a linear strip. After a course of two inches the long and outer heads fuse to form a fleshy belly, and this receives the inner head an inch more distal. The muscle is inserted by muscular and tendinous fibres into the tip and dorsal surface of the olecranon, a bursa intervening between the muscle and the capsule of the elbow joint.

A broad bundle of fibres arising from the deep surface of the distal half-inch of the triceps runs to the capsule of the elbow joint and represents the *subanconeus*.

Champneys (**11**) states that the triceps, anconeus, and sub-anconeus are as in Man. Hepburn (**24**) mentions that the triceps is as in Man except for the outer head, and mentions that the anconeus is present.

The *palmaris longus* is absent in both arms in this specimen. Traill (**49**) only noted it in one of the arms in his example. Many authors describe it as being similar to that in Man.

The *pronator radii teres* has both humeral and coronoid heads of origin, and the median nerve dips between them. The head from the internal condyle of the humerus is fused with the origin of the flexor carpi radialis, and the coronoid head is fused with the deep aspect of the flexor sublimis digitorum. It is inserted into the middle third of the outer border of the shaft of the radius, and a few fibres at the upper extremity are inserted into the inner aspect of the supinator brevis. The upper part of the insertion is tendinous, but the remainder is muscular. Throughout its whole length it is fused with fibres of the flexor carpi radialis. No fibres arose from the dorso-epitrochlearis, but a few spring from the extreme distal end of the internal intermuscular septum. Macalister (**33**) alone states that there is no coronoid head of origin.

The *flexor carpi radialis* has an extremely long origin by a thick muscular belly, which is intimately fused with the pronator radii teres and flexor sublimis digitorum. In the second fourth of the forearm it has no bony attachment, but many fibres run downwards from the pronator teres and flexor sublimis to its tendon. Below that it is attached by muscle fibres to the radius on the inner aspect of the insertion of the pronator teres, and fibres pass downwards from it to the flexor sublimis. The tendon receives muscle fibres on its deep aspect till it reaches the annular ligament. It passes through a tube in the ligament and is inserted into the palmar aspect of the bases of the second and third metacarpal bones. It has a well-marked synovial sheath fused with the anterior annular ligament.

The *flexor carpi ulnaris* arises by a narrow head from the internal condyle, by an expanded head from both internal condyle and olecranon, and by fascia from the upper fourth of the shaft of the ulna. It is inserted into the pisiform bone. It is relatively larger than in Man, and the pisiform is very large.

The *flexor sublimis digitorum* appears to differ considerably. In my specimen it has a very extensive origin from the humerus, ulna, and radius; and fibres spring from those of the other flexor muscles. The humeral head, arising from the internal condyle of the humerus, fuses with the flexor carpi radialis, and receives a few fibres from the flexor carpi ulnaris. It is prolonged almost entirely into the tendons for the ring and little fingers, the tendon for these digits separating off in the middle of the forearm. The coronoid head is fusiform and quickly ends in a tendon which forms the slip to the index finger. The second finger gets its tendon from a muscle which arises from the lower two-thirds of the shaft of the radius and from the flexor carpi radialis. Hepburn (**24**) states that the tendons to the third and fourth digits come from the radial part of the muscle, while those for the second and fifth come from the ulnar part; and the tendon

for the index goes under those for the second and fourth digits. Champneys (**11**) states that the middle finger alone has a separate radial origin, but Rolleston gives the radial origin to the tendon for the index. Macalister (**33**) observed no radial origin at all. Moore (**36**) states that the annularis receives two tendons, and the minimus gets none. Finally, Bland-Sutton (**4**) describes the flexor sublimis tendons going to the third, fourth, and fifth digits, but there is a flexor sublimis indicis arising from both radius and coronoid. Dwight (**18**) describes a very complex muscle. The tendons split over the heads of the metacarpal bones, surround the deep flexor tendons, and are inserted as in Man into the middle phalanges.

Muscles of the Hypothenar Eminence (text-fig. 35 A & C):—The *abductor minimi digiti* (A.M.D) arises by a broad, but thin, muscular origin from the pisiform bone. It lies along the ulnar border of the hand and is inserted by a long, slender tendon into the ulnar aspect of the base of the first phalanx of the little finger. Its insertion is closely blended with that of the flexor brevis. The *flexor brevis minimi digiti* (F.B.M.D) has a single head of origin from the anterior annular ligament and hook of the unciform; and the annular ligament appears to be prolonged into it. It is inserted along with the abductor. The *opponens minimi digiti* (O.M.D) has a double origin from the anterior annular ligament and uncinate process of the unciform, the latter being blended with the flexor brevis. It is inserted into the ulnar aspect of the shaft of the fifth metacarpal bone. The *palmaris brevis* is very extensive in both hands, but several authors describe it as in Man.

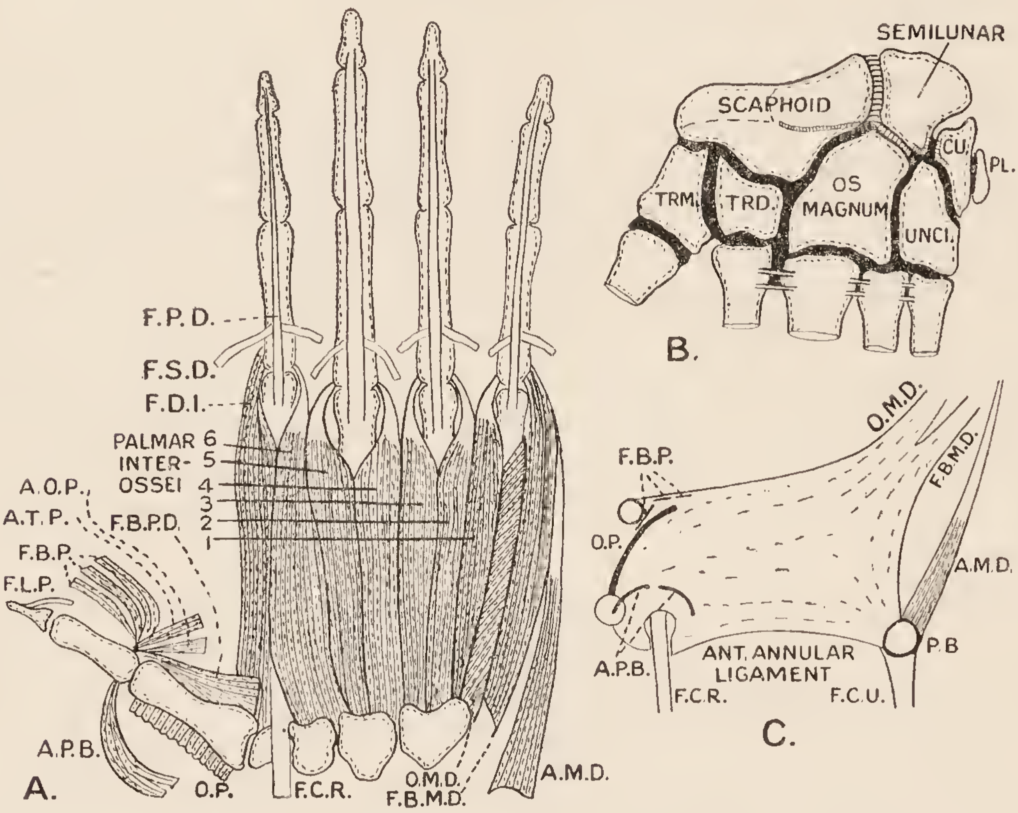
Muscles of the Thenar Eminence (text-fig. 35 A & C):—The *abductor pollicis brevis* (A.P.B) arises from the anterior annular ligament, the scaphoid and sesamoid bone and the sesamoid bone of the thumb, and it is divided into two slips. These unite to a muscular insertion into the radial side of the base of the first phalanx of the thumb. It conceals the lateral half of the opponens. Champneys (**11**) and Macalister (**33**) saw no splitting into Sœmmering's slips. The *opponens pollicis* (O.P) arises from the anterior annular ligament and ridge of the trapezium. It is inserted into the distal half of the radial aspect of the shaft of the metacarpal of the thumb. Embleton (**19**) states that the opponens pollicis is absent. The *flexor brevis pollicis* (F.B.P) consists of superficial and deep parts. The superficial part arises by three slips from the anterior annular ligament and trapezium. The deep part arises from the ulnar side of the first metacarpal and anterior annular ligament. Both parts unite and are inserted into the ulnar side of the base of the first phalanx. The whole muscle forms a large mass between the opponens superficially and the adductores deeply. The *adductor transversus pollicis* (A.T.P) and *adductor obliquus pollicis* (A.O.P) are as in Man.

The *flexor longus pollicis* (F.L.P) arises from the inner surface of the shaft of the radius over the whole length except the

proximal inch, and from the interosseous membrane. Some fibres fuse with the flexor sublimis. It has a strong tendon to the palmar aspect of the terminal phalanx of the index, and a very fine tendon to the corresponding part of the pollex. This agrees with the descriptions of Champneys (**11**), Hepburn (**24**), and others.

The *flexor profundus digitorum* arises from the inner side of the olecranon, the inner surface of the upper two-thirds of the shaft of the ulna and the interosseous membrane; and some of the fibres fuse with the flexor sublimis and flexor carpi ulnaris. The strong tendon divides into three tendons running to the palmar aspects of the terminal phalanges of the third, fourth,

Text-figure 35.



The muscles and joints of the hand. F.B.P.D: deep part of the flexor brevis pollicis; F.C.R: flexor carpi radialis; F.C.U: flexor carpi ulnaris; F.D.I: first dorsal interosseous muscle; F.P.D: flexor profundus digitorum; F.S.D: flexor sublimis digitorum. Other letters in text.

and fifth digits. There is no continuity with the flexor longus pollicis. Several authors have described similar conditions.

The *pronator quadratus* runs downwards and outwards from the lower inch and a half of the front of the shaft of the ulna to the lower inch of the front of the shaft of the radius. Fibres wrap round both bones and extend down to the interosseous membrane.

Lumbricales:—These arise as in Man, and the general disposition is similar, but a well-marked muscular slip connects the first and second. The first and second muscles have long origins from the flexor tendons, but the second and third muscles quickly

separate from the tendons. The insertions are as in Man. Hepburn (24) and Macalister (33) describe them as in Man. Wilder (53), Dwight (18), and Champneys (11) state that the tendon for the minimus arises from the profundus tendon to the annularis.

The *supinator longus* arises from the external supracondylar ridge and from the shaft of the humerus as high up as the insertion of the deltoid. Some fibres come from the external muscular septum, and some from the brachialis anticus. It has a long tendon which is inserted into the shaft of the radius half an inch above the styloid process. Some authors have recorded slightly less or a little more extensive origin and insertion. This animal agrees in this respect with Hepburn's account (24).

The *extensor carpi radialis longior* arises from the lower part of the external supracondylar ridge and septum. Its tendon separates very high up in the forearm, passes under the extensors of the thumb, and is inserted into the radial side of the dorsal aspect of the index metacarpal, and along the radial aspect of the proximal half inch of the bone. This insertion is more extensive than in some accounts.

The *extensor carpi radialis brevior* arises from the lateral epicondyle, the external lateral ligament of the elbow joint and the fascia over the extensor communis digitorum. It is slightly fused with the long extensor. It is inserted into the dorsal aspect of the base of the third metacarpal by three small tendons.

The *extensor communis digitorum* arises from the external epicondyle, the fascia over it, and the intermuscular septa on either side. It remains fleshy to the posterior annular ligament. The origin from the internal septum is particularly strong. It is quite separate from the subjacent extensors. It separates into three broad tendons to the index, medius, and annularis, and a slender tendon goes to the minimus. Close to the heads of the metacarpals there is strong lateral fusion between the tendons to annularis and minimus. The tendons are inserted into the bases of the ungual phalanges. Wilder (53), Vrolik (51), Moore (36), and Macalister (33) deny the presence of a tendon to the minimus. Dwight (18) and Champneys (11) say there is a slip between the tendons to annularis and minimus. The tendons have very powerful thickened expansions into the sides of the interphalangeal joints.

The *extensor minimi digiti* has a long, slender muscular belly enclosed in a strong fascial tunnel. It arises from the fascia over the anconeus, and from the common extensor origin from the external epicondyle. A common dorsal expansion unites its tendon to the innermost communis tendon over the head of the fifth metacarpal. The expansion is very firmly adherent to the capsule of the metacarpo-phalangeal joint. The insertion is into the base of the ungual phalanx of the minimus.

The *extensor carpi ulnaris* is as in Man. Several authors describe this.

The *extensor indicis* arises from the inner surface of the lower fifth of the radius, and some fibres blend with the extensor longus pollicis. Its long, and very slender tendon blends with the dorsal expansion of the communis tendon to the index over the first phalanx. No slip goes to any other digit, as in Wilder's specimen (**53**). Hepburn (**24**), Macalister (**33**), and Humphry (**26**) found it supplying the medius too.

The *supinator brevis* is wrapped round a little more than the upper third of the radius. It is musculo-tendinous.

The *extensor ossis metacarpi pollicis* and *extensor primi internodii pollicis* have a common origin from the bones of the forearm. The latter arises from the upper third of the lateral border of the ulna, and the former from the upper two-thirds of the mesial border of the radius. The tendons separate from the combined muscular mass. The broad tendon of the former runs to the trapezium and thumb sesamoid, and the slender tendon of the latter goes to the base of the metacarpal of the thumb.

The *extensor secundi internodii pollicis* (extensor pollicis longus) arises from the third fourth of the inner surface of the shaft of the ulna below the extensor primi internodii pollicis and above the extensor indicis. Its long, ribbon-like tendon is inserted into the base of the ungual phalanx of the thumb. Hepburn (**24**) gives its insertion as the base of the first phalanx, but Humphry (**26**), Macalister (**33**), Vrolik (**51**), Wilder (**53**), and Wyman (**54**) recorded conditions as in my specimen.

Interossei:—All authors agree that the dorsal interossei are as in Man, and several have described the six interossei on the palmar surface of the manus. Hepburn (**24**) has shown that three of the six muscles are the true palmar interossei, namely, those to the ulnar side of the index and the radial sides of the annularis and minimus. The others to the sides of the medius and ulnar side of the annularis are abductors, belonging really to the dorsal series. With his observations I am quite in agreement. The six palmar muscles form a very thick stratum. The conditions are shown diagrammatically in text-fig. 35 A. The first dorsal interosseous wraps round the metacarpal of the index. Taking the deep muscles from within outwards, we find:—

1. Opponens minimi digiti; 2. palmar adductor interosseous to the minimus; 3. palmar abducting interosseous of the annularis; 4. palmar adducting interosseous of the annularis; 5. palmar interosseous deviating the medius to the ulna; 6. palmar interosseous deviating the medius to the radius; 7. palmar adducting interosseous of the index; 8. pollical head of the first dorsal interosseous covering the metacarpal of the index; 9. deep head of the flexor brevis pollicis.

Muscles of the Anterior Abdominal Wall.

The *external oblique* arises by well-marked digitations from the outer surfaces and lower borders of ribs 5-11. The mesial

digitations fuse with the pectoralis major, and the outer ones are only covered by the latissimus dorsi. All interdigitate with the serratus magnus. The lateral fibres descend to the anterior superior iliac spine and outer third of Poupart's ligament. The other fibres end in the aponeurosis which is attached to the sternum, the last chondro-sternal junction, the pubis, and the inner two-thirds of Poupart's ligament. The aponeurotic fibres of the two sides cross the mid line into one another. Gratiolet (**11**) described the aponeurosis in detail, recording the characters of Poupart's ligament, the slight Gimbernat's ligament, the lax adhesion to the deep fascia of the thigh, and the formation of the pillars of the external abdominal ring. The aponeurosis fuses with the internal oblique mesial to the splitting of the aponeurosis of the latter. And the crural fascia and Poupart's ligament fuse with the aponeurotic origin of the sartorius.

The *internal oblique* rises from the outer half of the anterior border of the iliac crest, the anterior superior iliac spine, the outer third of Poupart's ligament, and the lower borders of costal cartilages 10–13. The aponeurosis, which receives the fibres, has a curved line of splitting and runs from the tenth costal cartilage to the inner end of Poupart's ligament.

The *transversalis abdominis* arises from the deep surfaces of ribs 10–13, the lumbar fascia, the anterior quarter of the inner lip of the iliac crest, the inner surface of the anterior superior iliac spine, and the outer third of Poupart's ligament. The aponeurosis is attached to the xiphoid and pubis.

The sheath of the rectus is as in Man, and the semilunar fold of Douglas is present. The *rectus* has two origins, as in Man, but has four inscriptions running right through it to the sheath *Pyramidalis* is absent.

The *diaphragm* has a comparatively small central tendon receiving muscles arising from ribs 7–13 and interdigitating with the transversalis abdominis, from the back of the sternum by two slips, and from the lumbar vertebræ by the crura and extra slips. The right crus arises as low down as the second lumbar vertebra, and the left one from the first. A slip arises from the transverse process of the second lumbar vertebra and one from the side of the body of the first. The lumbo-costal arches are as in Man.

The *quadratus lumborum* is related to the lumbar fascia as in Man. It arises from the posterior two-thirds of the inner lip of the iliac crest, where it is continuous with the iliacus, and from all the lumbar transverse processes. It is inserted into the inner four-fifths of the last rib and the bodies of the last two dorsal vertebræ.

Muscles of the Pelvic Extremity.

The *psoas parvus* arises by fleshy fibres from the last dorsal and first lumbar vertebræ, and it is connected by a fascial sheet over the psoas magnus to the remaining lumbar transverse

processes. Its broad, flat tendon is attached to the ilio-pectineal line close to the emergence of the femoral vessels.

The *iliacus* arises as in Man. It is quite continuous with the quadratus lumborum, and it soon fuses with the psoas magnus. Its fibres envelop the psoas from each side. The *psoas magnus* blends more with the iliacus than in Man. It arises from the last dorsal vertebra, the inner inch of the last rib and the bodies and transverse processes of all the lumbar vertebræ. The combined muscle is inserted into the small trochanter and the femoral shaft a little below it. Half of the muscle (mesial part) passes over the ilio-psoas tendon and is inserted into the bone posterior to the latter.

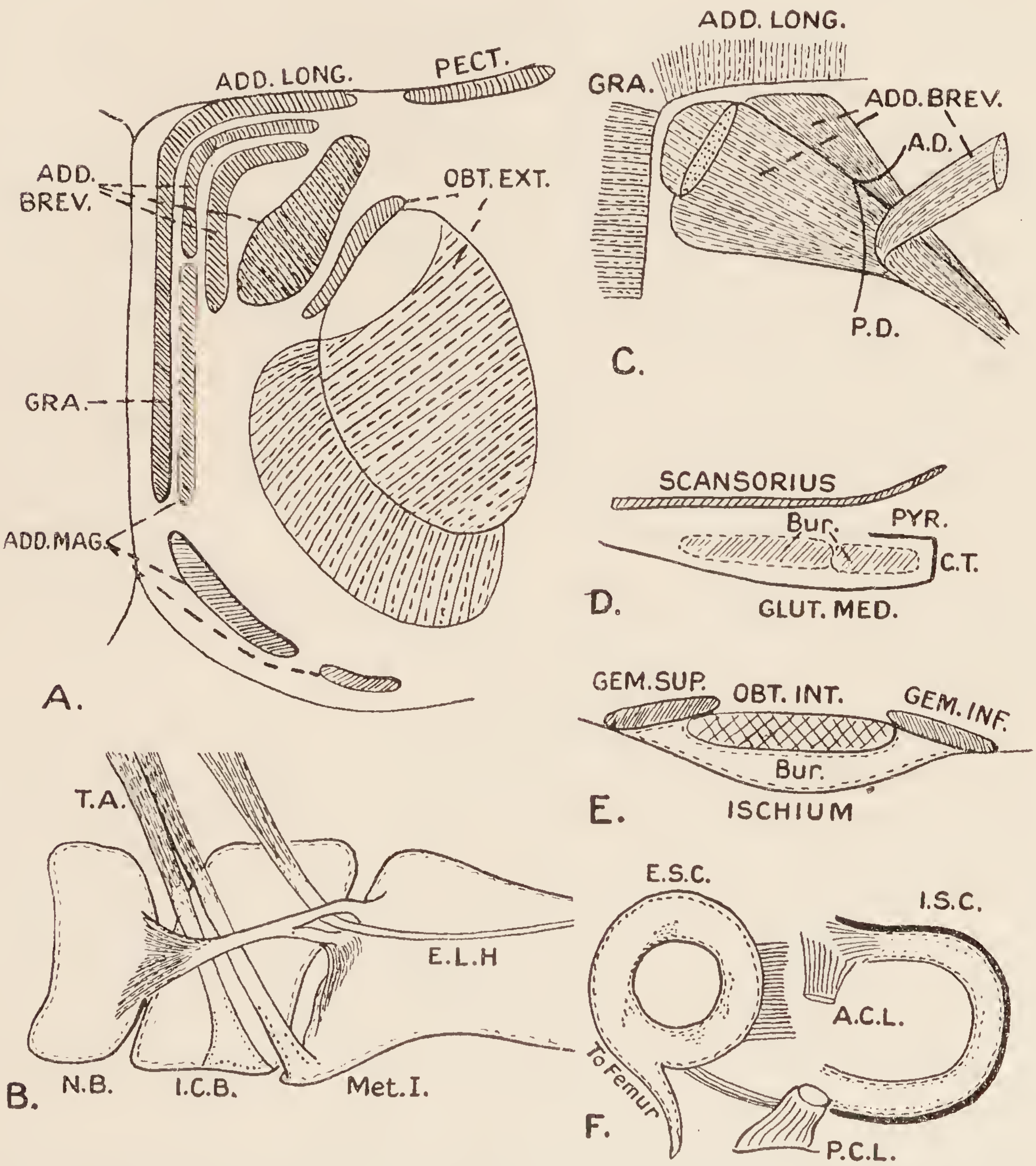
The *sartorius* has a large fan-shaped aponeurotic origin from the anterior edge of the ilium up to a point a finger's breadth below the anterior superior spine. Superficial to the aponeurosis, but connected to it by fascia, is a long, narrow fascial strip connecting the muscle to the anterior superior iliac spine. The strip is connected to the crural fascia and fascia over the abdominal muscles, thus forming a tunnel for the ilio-psoas. The comparatively slender muscle is inserted into the upper third of the anterior border of the tibia from the attachment of the ligamentum patellæ downwards. Strong fascia unites it to the inner tuberosity of the tibia and the internal lateral ligament of the knee. Between it and the subjacent gracilis is the saphenous nerve, but no bursa.

The *gracilis* and *adductor longus* (text-fig. 36, Gra. and Add. Long) arise by a common aponeurosis from the inner end of Poupart's ligament, the entire length of the side of the symphysis, and upper third of the descending ramus of the pubis. No other author describes a precisely similar origin. And the origin conceals the adductor magnus. The adductor longus occupies the greater part of the aponeurosis, and its fibres approach closer to the bones; it is inserted into the third quarter of the back of the shaft of the femur, and it is fused with the magnus. Hepburn (**24**) describes it as arising by a rounded tendon, and Humphry (**26**) gives its origin as the spine and inner half of the horizontal ramus of the pubis. The gracilis is inserted into the inner aspect of the tibia behind the internal lateral ligament. It is fused with the subjacent semitendinosus and the fascia over the inner head of the gastrocnemius. Gratiolet (**22**), Champneys (**11**), and Hepburn (**24**) give more extensive origins for a separate gracilis.

The *adductor magnus* (text-fig. 36, Add.Mag) arises by three heads from the pubis and ischium, and it is inserted into the upper three-quarters of the back of the shaft of the femur. The upper head arises from the entire length of the body of the pubis: the middle head from the arch and ischial tuberosity: and the lower head from the tuberosity. The upper and mid heads unite to form a thick muscle inserted into the femoral shaft. The lower head runs separately to the adductor tubercle,

and the femoral vessels pass between the two parts to the popliteal space. Champneys (**11**) reviews the various descriptions. Dwight (**10**) describes fusion of all the adductors except the part of the magnus to the tubercle. Hepburn (**24**) states that the latter is really a hamstring, and is supplied by the sciatic nerve. I did not observe fibres from the main mass reaching the knee.

Text-figure 36.



Muscles and joints of the pelvic extremity. A.C.L: anterior cruciate ligament; C.T: fibrous connecting slip; E.L.H: extensor longus hallucis; E.S.C: external semilunar cartilage; I.C.B: internal cuneiform bone; I.S.C: internal semilunar cartilage; Met.I: first metatarsal bone; N.B: scaphoid or navicular; P.C.L: posterior cruciate ligament; PYR: pyriformis; T.A: tibialis anticus. Other letters in text.

The *adductor brevis* (text-fig. 36, ADD.BREV) arises by three prismatic, interlocking bellies from the angle between the body and horizontal pubic ramus. Its flat tendon is inserted into a line from the small trochanter to the middle of the back of the femur.

The *pectineus* (text-fig. 36, PECT) arises from the pubic crest on

the three-quarters of an inch internal to the longus. It has a curved insertion running from the lesser trochanter to the back of the shaft of the femur.

Hamstring Muscles:—With the exception of the short head of the biceps, all the hamstrings arise together from the lower and back part of the tuber ischii, and all are fused. The *semitendinosus* is inserted into the anterior tubercle of the tibia, and by a large expansion to the fascia of the leg. The tendon is not as long as in Man (Vrolik and Hepburn), and the insertion is lower. Cuvier showed that this low insertion is incompatible with an erect attitude, and Rolleston pointed out that it occurs in children. The insertion of this muscle, and that of the semimembranosus move upwards as the body becomes erect. The *semimembranosus* is smaller than the last muscle, and its long, flat tendon sends no fibres to the fascia over the popliteus, nor to the internal lateral ligament. It is inserted into the tibia over a small area proximal to the other hamstrings. The *biceps* differs somewhat in my specimen from the accounts of Hepburn (**24**) and Champneys (**11**). Both heads remain separate. The ischial head has a strong insertion into the outer side of the head of the tibia, the head of the fibula, and the fascia over the outer head of the gastrocnemius. The femoral head is inserted into the head and proximal inch of the shaft of the fibula, and the fascia over the gastrocnemius. It is, therefore, evident that the hamstrings and some of the adductor group are connected to the fascia over the gastrocnemius.

The *gluteus maximus* is smaller than in Man. It arises from the side of the sacrum and coccyx, the great sacro-sciatic ligament and the ischial tuberosity along with the long head of the biceps. No muscle fibres arise from the iliac crest, as in *Phascolarctos*, but it arises from the strong fascia which covers the gluteus medius, and is attached to the iliac crest. Hepburn (**24**) saw it arising from the crest, Humphry (**26**) observed no fascial origin, and Champneys (**11**) described conditions similar to mine. The insertion is longer than in Man, for it is fixed to the back of the femur as low down as the external condyle, and to the shaft below the great trochanter. Its fibres mingle with the vastus externus. It is fused with the outer head of the gastrocnemius (Humphry, **26**), and with the tensor fasciæ femoris (Wilder, **53**).

The *gluteus medius* has a fleshy origin from the whole of the dorsum ilii down to the line from the great sciatic notch to the anterior inferior spine, and by a dense aponeurosis from the anterior border between the superior and inferior spines. The aponeurosis gives way to muscle after an inch. Fibres also arise from the posterior aspect of the aponeurosis. It is inserted into the top of the outer aspect of the great trochanter. A small slip runs from the mesial aspect of the tendon to join the tendon of the pyriformis, thus bringing the two tendons into connection. Two communicating bursæ (text-fig. 36, Bur) separate the

tendons of gluteus medius from those of the scansorius and pyriformis. It is the largest of the glutei. The whole insertion is by closely-set ribbon-like muscles. None of these forms a separated part as described by Champneys (**11**), but the insertion is split slightly by the vastus externus, as described by Hepburn (**24**).

The *scansorius* arises from the body of the ilium by a thick muscular origin, and by a thin curved origin from the ilium an inch behind and parallel to the acetabulum. The most external fibres come into relation with the gluteus minimus. It passes over the acetabulum and head of the femur to be inserted into the capsule of the hip from the head to the top of the great trochanter, and to the anterior border of the great trochanter internal to the pyriformis, gluteus medius and vastus externus. It is continuous above with the obturator internus and the gemelli, and below with the gluteus minimus.

The *gluteus minimus* arises from the anterior border of the ilium from the anterior superior spine to below the anterior inferior spine. It is on a slightly more anterior plane than the scansorius. Its insertion is linear and continues that of scansorius downwards for a centimetre. The insertion is covered by the vastus externus.

The *tensor fasciæ femoris* arises from the back of the iliacus, and is inserted into the fascia of the leg more than half-way down the leg. Some authors have stated that the scansorius corresponds to the tensor fasciæ, and others describe only the former. Champneys (**11**) describes both.

The *gemellus superior* (text-fig. 36, GEM.SUP) arises from a small area on the outer surface of the ischial spine, and from the attachment of the lesser sacro-spinous ligament above the groove for the tendon of the obturator internus. The *gemellus inferior* (text-fig. 36, GEM.INF) arises within the pelvis from a linear origin, and from the top of the outer aspect of the tuber ischii below the groove for the tendon of the obturator internus. The *tendon of the obturator internus* (text-fig. 36, OBT.INT) formed by a fusion of fascicles, is separated from its groove in the ischium by a bursa. It is overlapped by the gemelli which fuse over it. They all have a common insertion into the femur above the trochanteric pit. It is intimately connected to the capsule of the hip joint. Between the hip joint and the tendons of obturator internus and gemelli and the quadratus femoris and obturator externus there is a pad of fat. Hepburn (**24**) states that the gemellus superior is less than the inferior, and it is difficult to separate the latter from the quadratus femoris, but that is not the case in this animal. Champneys (**11**) agrees with me in the relative sizes of the gemelli.

The *quadratus femoris* arises from the inferior ramus and upper edge of the tuber ischii above the origin of the hamstrings. It has an angular insertion into the lower part of the inter-trochanteric crest and lesser trochanter, and then horizontally

outwards for an inch into the upper end of the insertion of the adductor brevis.

The *obturator externus* (text-fig. 36, Obt.Ext) arises by two heads. The large head arises from the inferior ramus of the pubis between the obturator foramen and the origins of the adductor magnus, and from the obturator fascia. The small head arises from the horizontal ramus of the pubis between the obturator canal and origin of the lateral head of the adductor brevis. The two heads unite, and the tendon is inserted into the trochanteric pit and capsule of the hip joint.

There is greater connection between these muscles, and the capsule of the hip joint is considerable.

The *rectus femoris* arises by two heads which, however, are not very distinctly separate. The straight head arises from the anterior aspect of the ilium between the anterior inferior spine and the acetabulum. The reflected head forms an arch over the whole of the upper part of the acetabulum, and the upper fibres are connected by a dense aponeurosis with the iliacus. The *vastus externus* arises from a small area on the antero-lateral aspect of the great trochanter below the insertion of the scansorius, whose tendon it splits. The origin is continued down on the back of the femur, anterior to and continuous with the gluteus maximus, to an inch above the external condyle. A small part, arising from the anterior part of the bone below the great trochanter, is at first separated from the main mass by the gluteus minimus. And an additional slender belly springs from the upper end of the intertrochanteric line. The *vastus internus* arises from the intertrochanteric line except its extreme upper end. And it springs from the back of the femur down to a point an inch above the internal condyle. The *crureus* arises from the upper two-thirds of the surface of the femur between the two vasti. The *quadriceps extensor tendon* is wide and receives the muscles an inch above the patella. It is attached to the upper border of the patella, the capsule of the joint on either side of it, the internal condyle of the tibia, and the outer femoral and tibial condyles. The ligamentum patellæ is inserted into the front of the upper end of the tibia. No *subcrureus* is present.

Tibialis Anticus:—Macalister (**33**), Hepburn (**24**), Champneys (**11**), and others have described double origins and insertions. The insertions are into the entocuneiform and first metatarsal. Wilder (**53**) points out that the double insertion is in accord with the use of the hallux as a thumb. In this animal the origin is from the outer aspect of the outer condyle and the upper half of the outer aspect to the tibia, from the middle third of the delicate interosseous membrane, from the fascia between it and the extensor longus digitorum, and from the fascia over it. The lateral superficial fibres form the superficial belly of the muscle, which is inserted into the base of the first metatarsal bone. The other fibres form the deep belly, which runs to the internal cuneiform (text-fig. 36 B). The superficial belly has a mucous

sheath almost to its insertion; but the deep belly loses its sheath on the dorsum of the foot, and is separated from the cuneiform bone by a bursa.

The *extensor longus digitorum* arises from the external condyle of the tibia internal to the head of the fibula, the anterior border of the head of the fibula, the antero-medial surface of the fibula to within an inch of the malleolus, the anterior peroneal intermuscular septum to the same level, the fascia between it and the tibialis anticus and the fascia over its upper half. The belly passes through the lateral compartment under the annular ligament, and divides into four slips. The second slip is thready, but the others are well developed. The first slip divides into two; the medial one going to the dorsum of the second toe, and the lateral one joins the second slip and runs to the third toe. The third and fourth slips run to the fourth and fifth toes. The slips form dorsal expansions over the metacarpo-phalangeal joints and proximal phalanges, which are joined by the lumbricales, interossei, and extensor brevis, except in the case of the fifth toe. The actual insertions into the bones are as in Man.

The *extensor longus hallucis* arises from the middle third of the antero-medial surface of the shaft of the fibula, and from the outer part of the interosseous membrane, posterior to the extensor digitorum longus. The belly passes through the middle compartment under the anterior annular ligament, and continues as a tendon round the inner surface of the entocuneiform. It runs through the naviculo-metatarsal trochlea (text-fig. 36 B) and reaches the dorsum of the metatarsal of the hallux. A dorsal expansion is formed over the first phalanx, the proximo-lateral part of which joins the tendon of insertion of the most medial tendon of the extensor brevis digitorum. The rest of the tendon has an expanded insertion into the base of the terminal phalanx of the hallux and the capsule of the interphalangeal joint.

The *peroneus tertius* is absent.

The *gastrocnemius* has two heads, but they arise more posteriorly and distally than in Man, and from the capsule of the knee joint instead of from bones. They spring from the capsule over the articular surface. They are inserted into a median tendinous raphé, the inner belly slightly overlapping the external, and extending more laterally. The flattened tendon joins the tendon of the soleus, half an inch above its insertion into the calcaneus, forming the tendo Achillis. The edges of the muscle are firmly connected to the subjacent soleus.

The *plantaris* arises lower down than in Man, from the posterolateral side of the external femoral condyle. The slender belly, three inches long, passes under the lateral belly of the gastrocnemius, and the very fine thread-like tendon has an expanded insertion into the tendo Achillis close to the calcaneus.

The *soleus* has no tibial origin, and is smaller than in Man. It has a fleshy origin from the posterior aspect of the head of the fibula, and an aponeurotic origin from the upper part of the

peroneal intermuscular septum. The flat belly gradually expands till it reaches a point an inch above the calcaneus. The superficial part of the central portion becomes tendinous in the lower third, and is joined by the gastrocnemius to form the tendo Achillis. The tendo Achillis is inserted into the middle of the posterior aspect of the os calcis. It is separated from the upper part of the bone by a bursa and a pad of fat.

The *popliteus* is double, but its origins and insertions are all in contact to form linear attachments. The proximal fibres rise from the posterior aspect of the capsule of the knee-joint internal to the outer head of the gastrocnemius. The distal fibres arise as in Man. The proximal part is inserted into the vertical line on the posterior aspect of the internal tibial condyle. The distal part goes to the oblique popliteal line, the posterior border of the subcutaneous area, the internal condyle and a curved line running round the internal condyle.

The *flexor longus digitorum* arises from the popliteal line and its medial continuation downwards to within half an inch of the inner malleolus, and from the septum between it and the tibialis posticus. The tendon passes round the back of the internal malleolus and under the inner end of the internal annular ligament. It crosses to the lateral side of the sole of the foot and is joined by the tendon of the accessorius and a slip from the flexor longus hallucis. A small slip runs to the lateral tendon of the flexor brevis digitorum. Then it divides into five tendons for the four inner toes, the fourth receiving two. The first and second tendons, to the second and third toes, are accompanied superficially by tendons of the flexor brevis. In the case of the fourth toe the superficial tendon of the longus replaces the tendon of the brevis. The tendons are inserted as in Man. The tendon to the little toe is attached by a broad vinculum to the body of the proximal phalanx, by a triangular vinculum to the second phalanx and is inserted into the base of the terminal phalanx. The flexor sheaths are as in Man.

The *four lumbricales* pass to the inner parts of the dorsal expansions of the extensor tendons of the four inner toes.

The *accessorius* is very small and has only the external head which runs from the outer edge of the calcaneus and the long plantar ligament to the outer aspect of the flexor longus digitorum.

The *flexor longus hallucis* arises from the lower part of the posterior aspect of the head of the fibula, from the posterior surface of the fibula almost to the malleolus, from the fascia between it and the tibialis posticus, from the posterior peroneal intermuscular septum, the lower part of the interosseous membrane and slightly from the tibia near the interosseous membrane. The tendon is inserted into the base of the terminal phalanx of the hallux, and the capsule of the interphalangeal joint. In the sole a large tendon connects it to the flexor longus digitorum. It has a flexor sheath. The tendon runs through a trochlea attached to the base of the first metatarsal.

The *tibialis posticus* arises from the lower part of the head and upper part of the body of the fibula anterior to the flexor longus hallucis, from the upper half of the interosseous membrane, the upper half of the tibia external to the popliteal line and its downward continuation and from the septum between it and the long flexors. It is inserted much as in Man, only the scaphoid here has no definite tubercle.

The *peroneus longus* arises from the anterior half of the outer surface of the head of the fibula, the antero-lateral surface of the fibula to within an inch of the malleolus, the upper half of the anterior peroneal septum, the posterior peroneal septum and the fascia over it. The tendon passes behind the outer malleolus and external to the peroneus brevis, and from there on it is as in Man.

The *peroneus brevis* arises from the lower half of the antero-lateral surface of the fibula down on to the lateral malleolus, the anterior peroneal septum and the fascia over it. The tendon goes behind the outer malleolus and is inserted into the projecting base of the fifth metatarsal. An inch below the malleolus the tendon gives a slip to the dorsal expansion on the dorsum of the proximal phalanx of the fifth toe.

The *extensor brevis digitorum* arises from the outer side of the upper surface of the os calcis anterior to the posterior facet, the dorsal calcaneo-cuboid ligament and the lower border of the external annular ligament. Its four fleshy bellies end in slender tendons to the four inner toes. The most medial tendon has an expanded insertion into the base of the dorsum of the proximal phalanx of the hallux. The other three join the dorsal extensor expansions, thereby being inserted into the bases of the second and third phalanges.

The *flexor brevis digitorum* arises as in Man. It divides into two tendons, the lateral one to the third toe being joined by a slip from the long flexor. The medial one goes to the second toe. Insertion as in Man.

The *abductor hallucis* arises as in Man, and it also receives fibres from the inner side of the foot (internal annular ligament, scaphoid, entocuneiform and capsule of the metatarso-phalangeal joint). It is inserted into the inner aspect of the capsule of the first metatarso-phalangeal joint and the base of the first phalanx, with the interposition of a sesamoid bone. A small slip passes to the shaft of the first phalanx.

The *abductor minimi digiti* arises as in Man. It is inserted into the outer side of the projecting base of the fifth metatarsal (abductor ossis metatarsi quinti of Hepburn), the inner side of the base of the fifth metatarsal, the outer side of the plantar aspect of the capsule of the metatarso-phalangeal joint and base of the proximal phalanx, and the outer side of the shaft and the dorsal expansion on the first phalanx. Hepburn (**24**) mentions the latter in the Orang.

The *flexor brevis hallucis* has two bellies. The deep inner one

arises from the entocuneiform, the sheath of the peroneus longus tendon, the capsule of the first metatarso-phalangeal joint, and the lower half of the outer border of the first metatarsal. The outer belly arises from the sheath of the peroneus longus and the external long plantar metatarsal ligament where it is attached to the outer surface of the base of the fourth toe. No fibres arise from the cuboid. The two bellies together with the two adductores hallucis are inserted into the outer side of the base of the first phalanx of the hallux and the capsule of the joint with the interposition of a sesamoid. The internal head is really a first interosseous.

The *adductor obliquus hallucis* arises from the base of the third metatarsal and the proximal half of the external long plantar metatarsal ligament. The *adductor transversus hallucis* arises from the upper half of that ligament and from the internal long plantar metatarsal ligament, and the capsules of the second and third metatarso-phalangeal joints.

The *flexor brevis minimi digiti* arises from the plantar aspect of the fifth metatarsal bone and the sheath of the tendon of the peroneus longus. It is inserted into the capsule of the fifth metatarso-phalangeal joint and outer side of the base of the proximal phalanx.

The *opponens minimi digiti* arises from the proximal half of the plantar surface of the fifth metatarsal and the sheath of the peroneus longus. It is inserted into the inner side of the capsule of the metatarso-phalangeal joint. There are four dorsal and three plantar *interossei*, but Dwight (**18**) mentions a large number. The four dorsal interossei arise as in Man; but their insertions differ in that they abduct from a line drawn through the middle toe. This resembles the arrangement in the hand, but not in the human foot where the mid line runs through the second toe. Hepburn (**24**) records the line as resembling that in the human foot, but Champneys (**11**) and Cunningham (**13**) point out that in all Primates except the Gorilla and Lemur the interossei abduct the toes from a line through the middle one. The attachments of the dorsal interossei are as follows:—

No. 1 inserted into the inner side of the second digit.
2 ,, ,, ,, ,, ,, ,, ,, third ,,
3 ,, ,, ,, outer ,, ,, ,, ,, ,,
4 ,, ,, ,, ,, ,, ,, ,, fourth ,,

The three plantar interossei adduct towards the middle toe instead of the second as in Man. The first arises in the second interspace from the whole length of the outer side of the second metatarsal, and a few fibres arise from the base of the third metatarsal, as Hepburn (**24**) finds in the Gorilla. It is inserted into the outer side of the second toe. The second arises from the inner side of the fourth metatarsal and the ligamentous structure covering the bone. It is inserted into the inner side

of the same toe. The third is placed more superficially than the others, and lies in the same plane as the opponens minimi digiti. Its belly crosses the fourth space from its origin on the external long plantar metatarsal ligament, and the ligaments over the base of the fourth metatarsal to its insertion on the inner side of the fifth toe.

The dorsal interossei are inserted more into the proximal phalanx than into the dorsal expansion, but the plantar interossei exhibit the reverse.

The important points to be noted from the physiological point of view are:—1. The middle line of the foot runs through the middle toe instead of through the second, as in Man. So the interossei of the foot of the Chimpanzee act as they do in a hand. 2. There are no additional plantar interossei in the foot as there are in the hand.

The disposition of the muscles in four layers in the sole of the foot is as in Man.

The nature of the terminal part of the pelvic extremity is described on page 423.

Muscles of the Pelvis.

Levator Ani:—In this animal the levator ani consisted of the same parts as described by Lartschneider (32). The iliac portion arose from the margin of pelvis minor, and the pubic portion arose from the back of the symphysis pubis. It is inserted into the sides of the lower end of the rectum and the ano-coccygeal raphé.

The *ischio-coccygeus* is a small muscle running from the side of the coccygeal vertebræ to the inner aspect of the back part of the ischial tuberosity.

Lartschneider has described a pelvic diaphragm in a female Chimpanzee.

The *perineal muscles* differ from those in the human condition. The vulva and anus are very close together, so there is no true central point of the perineum, nor is there a trace of transverse perineal muscles. The *ischio-cavernosi* have long origins from the ascending pubic rami; they run over the crura clitoridis, and the opposite muscles are blended. The *sphincter vaginæ* is a strong collar surrounding the upper part of the vagina and extending backwards on to the rectum. It has a narrow anterior slip which fuses with the meeting point of the two ischio-cavernosi. The *sphincter ani externus* blends in front with the sphincter vaginæ, and it is attached behind to the ano-coccygeal raphé, which is very powerful.

The ischio-rectal fossæ are well marked and laden with fat. No well-marked bursa exists over the ischial tuberosities. And the fascia is not divided as in Man into a superficial fatty layer and a deep fascia of Colles.

The orbital muscles are described on page 415, and the laryngeal muscles on page 398.

The Joints.

Spinal Ligaments:—The *anterior common ligament* extends from the axis to the upper segment of the sacrum, and is smaller above than below. It is attached to the front of the centra, but not to the depressions between the vertebræ. The *supraspinous ligaments* run as in Man, and are connected to interspinous ligaments. There is no ligamentum nuchæ. The *interspinous ligaments* are as in Man. The *ligamenta subflava* run from the anterior aspect of the lamina above to the posterior aspect of the lamina below. They and the interspinous ligaments are very elastic. The *posterior common ligament* runs from the axis to the sacrum, but is not so dentate in appearance as in Man. It is narrow on the centra, and expanded over the intervertebral discs.

Costal Articulations (text-fig. 37 A & B):—Anteriorly the head of the rib is connected by a fan-shaped ligament, not divisible into three parts as it is in Man, and the fibres all gain attachments to the anterior common ligament (A.C.L). The upper fibres run to the vertebra above, and the lower ones to the vertebra below, where they are overlapped by the upper fibres of the next joint. Posteriorly the tubercle of the rib is attached to the transverse process of the vertebra by a capsule. The upper border of the neck of the rib is connected to the transverse process by a fan-shaped ligament (C-T.L.).

The *intertransverse ligaments* (I-T.L) are fan-shaped. They connect the tip of the transverse process above to the upper border of the transverse process below.

The lengths of the spinous processes of the cervical vertebræ are:—axial $\frac{5}{8}$ inch; 4th vertebra $\frac{3}{4}$ inch; 6th and 7th vertebræ $\frac{7}{8}$ inch.

Atlanto-axoid Joints:—The posterior atlanto-axoid ligament, from the posterior arch of the atlas to the upper border of the axis, corresponds to the ligamenta subflava elsewhere. It is strengthened by fibrous bands (text-fig. 37, F.B): *a*. From the transverse process of the axis to an elevation on the posterior arch of the atlas; *b*. A central atlanto-axoid band (C.A.B); *c*. Several small bands between the others. The *anterior atlanto-axoid ligament* is a very strong band continuing the anterior common ligament from the axis to the atlas.

Joints of the Occipital, Atlas, and Axis (text-fig. 37 D):—The *posterior occipito-atlantoid ligament* is a thin membrane running between the posterior arch of the atlas and the edge of the foramen magnum. It is strengthened by lateral bands, attached close to the condyles. It functions as a posterior capsular ligament. An internal capsular ligament runs from the inner border of the condyle to the superior articular process of the atlas. And a strengthening band runs from the posterior arch of the atlas to the occipital bone close to the attachment of the internal capsular ligament. The *anterior occipito-atlantoid*

ligament is a strong membrane continuing the atlanto-axoid ligament from the anterior arch of the atlas up to the anterior half of the circumference of the foramen magnum. The *membrana tectoria* continues the posterior common ligament up to the cranial surface of the basi-occiput where it spreads out in a fan-shaped manner. The *posterior occipito-axoid ligament* (P.O-A.L) is a strong band on each side on the deep aspect of the membrana tectoria. It extends from the antero-lateral part of the vertebral canal to the basi-occiput. It passes lateral to the odontoid process and covers the spinal aspect of the lateral part of the transverse ligament and conceals it from view. The *transverse ligament* (T.L) is a strong band running behind the odontoid process. It is attached by its extremities to the inner aspect of the inferior atlantic articular processes. The *cruciate ligament* has no inferior crus. The superior crus (S.C.C) is broader and shorter than in Man. It runs from the transverse ligament below to the basi-occiput below the membrana tectoria above. The *check ligaments* (C.L) are more horizontal than in Man. They run from the odontoid to the inner aspect of the occipital condyles. The *middle odontoid ligament* runs from the tip of the odontoid to the anterior edge of the foramen magnum. It is stronger and more horizontal than in Man. *Capsular ligaments* are as usual. As the odontoid runs farther upwards than in Man the ligaments are modified.

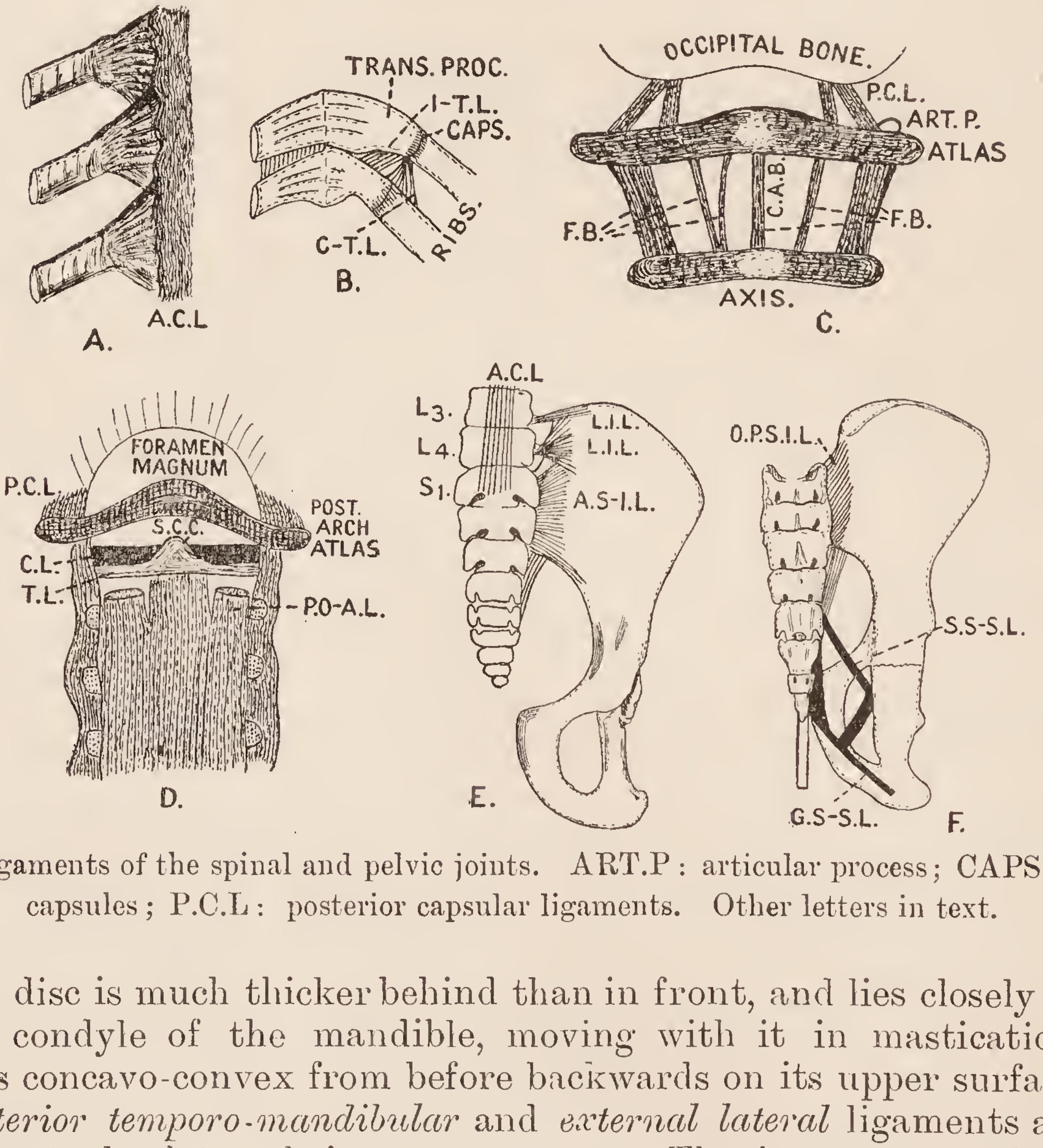
The lumbar vertebræ are connected by the usual capsular ligaments, intervertebral discs and ligaments connecting their processes.

Ligaments of the Pelvis (text-fig. 37) :—The lumbar vertebræ are included more closely between the ilia than in Man, and the pelvic ligaments differ in several respects. The *lumbo-inguinal ligaments* (L-I.L) consist of an upper horizontal ligament running from the third lumbar transverse process to the inner lip of the crest of the ilium, and a lower fan-shaped one from the fourth lumbar transverse process to the inner lip and inner surface of the ilium. The fibres of these ligaments are continuous; and the lower one is continuous with the *anterior sacro-iliac ligament* (A.S-I.L). The latter is fan-shaped, and runs from the ala sacri to the anterior surface of the ilium, where it spreads out in a fan-shaped manner. Some fibres run along the pelvic brim. The *short posterior sacro-iliac* ligament is as in Man. It is superficially thickened to form the *oblique posterior sacro-iliac ligament* (O.P.S-I.L), which runs from the posterior tubercles of the sacrum to the two posterior iliac spines and the bone between. The *great sacro-sciatic ligament* (G.S-S.L) runs from the side of the lower sacral and upper coccygeal vertebræ. It narrows and then it expands again on the posterior part of the inner aspect of the ischial tuberosity. A falciform process runs forwards to become the sub-pubic ligament. The ischial spine is slight, but it receives a broad expansion from the great sacro-sciatic ligament, and a cord-like *small sacro-sciatic ligament*

(S.S-S.L) from the side of the lower end of the sacrum. It can be seen from text-fig. 37, that the pelvic outlet is divided into seven parts by ligaments. The *obturator membrane* is dense and strong. The *symphysis pubis* has the same ligaments as in Man. The upper and sub-pubic ligaments are weak, but the anterior and posterior ones are strong, particularly the latter. Within the inter-articular cartilage there is a small synovial cavity.

The *Temporo-maxillary Joint* :—The *capsule* is thick and strong, the upper part of its outer surface giving origin to some of the deeper fibres of the masseter. The *synovial cavity* is divided into two by an articular disc which, however, is not perforated.

Text-figure 37.



Ligaments of the spinal and pelvic joints. ART.P: articular process; CAPS: capsules; P.C.L: posterior capsular ligaments. Other letters in text.

The disc is much thicker behind than in front, and lies closely on the condyle of the mandible, moving with it in mastication. It is concavo-convex from before backwards on its upper surface. *Posterior temporo-mandibular* and *external lateral* ligaments are present, the latter being very strong. The inner aspect of the capsule is thin. The *internal temporo-mandibular ligament* is small, but definite, and blends with the capsule. The anterior aspect of the capsule is covered by the insertion of the external pterygoid. The *spheno-mandibular ligament* is very poor.

The *acromio-clavicular joint* is as in Man.

The *Shoulder Joint* :—The shoulder joint is in many ways as in Man, but the following points deserve special mention. The

subscapular bursa opens into the joint cavity above the superior gleno-humeral ligament. The *coraco-humeral ligament* blends with the capsule near the insertion of the subscapularis. The *coraco-acromial arch* is a strong band, and there is also a weak *acromio-humeral ligament.* The insertions of the supraspinatus and infraspinatus are most intimately blended with the capsule, and cannot be separated from it. The posterior part of the capsule is weak and loose, but the anterior part contains a broad, powerful *anterior gleno-humeral ligament.* The capsule is attached to the bones as in Man. The *superior gleno-humeral ligament* divides into two parts, which are inserted separately into the humerus, and the subscapular bursa communicates with the joint between them. The cotyloid ligament and tendon of the biceps are as in Man.

The *Elbow Joint*:—The posterior part of the *capsule* is attached as in Man; and a strong band passes from the tip of the olecranon up to the outer part of the olecranon fossa, which contains fat. The anterior part of the capsule is relatively strong all over. On the radial side the fibres run downwards and inwards, but those on the ulnar side run downwards and outwards. The fibres of these sides interlace and make the capsule strong. The *internal lateral ligament* is very strong. It arises from the internal condyle and spreads out to be attached to the whole inner margin of the olecranon, the coronoid and the great sigmoid notch. The thickest parts are fixed to the olecranon and coronoid, but it has no transverse part. The *external lateral ligament* is attached as in Man. It is weaker than the internal ligament, but muscles arise from it.

The *Superior Radio-Ulnar Joint*:—The capsule of the elbow joint is prolonged down for $\frac{3}{4}$ inch over the head and neck of the radius. The orbicular fibres are as in Man, but there is no oblique cord. The *interosseous ligament* begins at the lower part of the coronoid process. One set of fibres runs downwards and outwards to be inserted into the radius below the bicipital tuberosity. A second group runs from the insertion of the first to the ulnar interosseous border; it is by far the stronger group, and lies anteriorly.

The *Synovial Cavity of the Elbow Joint*:—This is attached to the margin of the coronoid fossa, but more superiorly than the fossa for the head of the radius. The line of attachment then passes about half-way between the articular surfaces and the condyles. On the posterior surface the capsule is attached round the margin of the olecranon fossa. On the radial side the attachment corresponds to a line joining the epicondyles and drawn on the part of the humerus which articulates with the radius. On the ulnar side it is attached to the margin of the olecranon fossa, greater sigmoid notch and coronoid, but it jumps the gap between the margins of the lesser sigmoid notch, where it gives rise to orbicular fibres.

The *Wrist Joint*:—The anterior and posterior aspects of the carpus are covered by bands of fibres running in all directions; but

there is no centre of radiation as in Man. The following thickened bands deserve mention:—(1) A strong band from the anterior aspect of the base of the radial styloid to the trapezium and os magnum; (2) a weak *external lateral ligament*; (3) a small *internal lateral ligament*; (4) a thickened band from the posterior part of the distal radio-carpal joint to the back of the os magnum; (5) a posterior band from the distal part of the radius to the cuneiform and unciform bones. Both anterior and posterior ligaments are stronger than in Man. The *cavity of the joint* (text-fig. 35 B) is complicated. The distal end of the radius is divided into two facets, which articulate with the scaphoid and semilunar bones. No articular fibro-cartilage lies on the distal end of the ulna, but a very strong ligament runs from the distal end of the ulna to the proximal end of the pisiform bone. It plays over the outer aspect of the ulnar styloid, which is covered with cartilage. The synovial cavity between the radius and the scaphoid and semilunar bones is prolonged into the inferior radio-ulnar joint, over the ulnar styloid and ligament and upon the surface of the cuneiform bone; it gets in between the cuneiform and pisiform. A large cavity separates the head of the os magnum from the concave surfaces of the scaphoid and semilunar bones, and it also separates the cuneiform and unciform. It is continuous with the cavity between the scaphoid and trapezoid. A small ligament connects the scaphoid and os magnum and divides the cavity partially into inner and outer parts. This transverse carpal cavity is prolonged distally on either side of the os magnum. Two interosseous ligaments are also present in the joint. A sesamoid bone lying on the apex of the pisiform is separated from it by a synovial cavity and a strong interosseous ligament.

Carpo-metacarpal Joint:—A continuous cavity extends along the proximal ends of metacarpals 2–5. It is connected with the transverse carpal cavity (text-fig. 35). Two interosseous ligaments run from the os magnum to the sides of the third metacarpal bone. In the *intermetacarpal joints* there are prolongations of the carpo-metacarpal synovial cavity, and interosseous ligaments connect the second to fifth metacarpals to one another. The *metacarpo-phalangeal joints* are as in Man, but the dorsal expansions of the extensor tendons can easily be separated from the capsules. The *inter-phalangeal joints* are as in Man. Their internal and external lateral ligaments are powerful.

Pollical Joints:—A prolongation of the transverse carpal cavity runs between the scaphoid and trapezium, and between the trapezium and trapezoid, where there is also an imperfect interosseous ligament. A strong ligament runs from the trapezium to the base of the index metacarpal. The carpo-metacarpal capsule is complete; it is thick and strong on its outer and posterior aspects, but its inner and anterior aspects are weak. The metacarpo-phalangeal and interphalangeal joints are as in Man, and in the other digits of the Chimpanzee.

The *Hip Joint*:—The capsule is attached as in Man. The *ilio-femoral ligament* consists of one band, which arises under cover of the rectus femoris and is strengthened by its tendon. It runs as does the anterior band of the Y-shaped ligament in Man. No other ligaments are formed from the capsule. The gluteus minimus strengthens the capsule at the proximo-anterior part of the great trochanter. The ligamentum teres, cotyloid ligament, and transverse ligament are as in Man. The joint contains a pad of fat.

The *Knee Joint*:—The *ligamentum patellæ* is broad and strong, and has a more extensive insertion than in Man (see page 358). The *internal lateral ligament* is not inserted into the internal condyle of the tibia, but is fixed to the upper third of the shaft. The *external lateral ligament* is as in Man. The *oblique popliteal ligament* is absent, but a strong femoral intercondylar ligament is attached to the posterior aspects of the two condyles. The *ligamentum mucosum* is just as in Man. The *anterior cruciate ligament* is attached to the tibia as in Man, but its femoral insertion is into the upper half of the mesial aspect of the external condyle. It is smaller than the *posterior cruciate ligament*; the latter is attached to the tibia farther back than in Man, and it receives a slip from the external semilunar cartilage (text-fig. 36 F). Two *semilunar cartilages* are present. The internal one is larger than the external, and is crescentic in shape. It is attached in front of the anterior cruciate ligament. Its posterior horn is inserted as in Man. The external cartilage forms a small, complete circle. Internally it is attached by a broad ligament to the external side of the tubercles and spine of the tibia. Postero-mesially it is united by a ligament to the outer surface of the internal condyle of the femur. It is also connected to the posterior cruciate ligament. The joint differs in many ways from that in Man, and its construction is such that it is one of the factors which prevent the animal assuming a firm, erect attitude. Humphry (**26**), who has made a thorough study of this joint, points out that the femur in Man is broad and comparatively flat on the distal end of the external condyle; and the attachments of the lateral ligaments are nearer the posterior parts of the bone. So the joint is firm and locked when it is fully extended. In the Chimpanzee, on the other hand, the distal end of the external condyle is rounded, and the lateral ligament is not attached far back. He also shows that the lateral, cruciate, and posterior ligaments are all tight when the human knee is fully extended, but they never become simultaneously tight in the Chimpanzee; to obtain tightness of each ligament it is necessary to divide all the others. Finally, the attachment of the gracilis and hamstring muscles to the fascia of the leg, and the laxity of the ligaments of the joint, are contributory factors which prevent the animal assuming the erect attitude *.

* See the observations on living specimens recorded on page 420.

The *Ankle Joint*:—The capsule is attached above to the distal ends of the tibia and fibula and below to the astragalus. A small *deltoid ligament* runs from the medial and distal border of the tibia to the sustentaculum tali and talus. Posteriorly a very strong *fibular calcanean ligament* is present; and it is strengthened by an accessory ligament from the lateral aspect of the lower end of the fibula. A *tibial calcanean ligament* lies on the inner aspect of the joint. The *talo-fibular ligaments*, both anterior and posterior, are present, but the former is ill-defined. A ligament runs from the middle of the anterior distal border of the tibia, under the talus, to the medial aspect of the lateral distal tubercle of the calcaneus. The tibia and fibula are held together by thin membrane. The *talo-calcanean ligaments* are well-developed. The dorsal, posterior, and two lateral ones are strong, but the medial one is weak. The posterior ligament takes part in forming an interosseous ligament. The talus is further held in position by a ligament running from the plantar navicular-calcanean ligament to a small impression on the head of the talus.

Ligaments connected with the Calcaneus:—The plantar calcaneo-navicular ligament runs from the sustentaculum tali to the navicular; and there is practically no internal ligament between these bones. A well-marked ligament connects the calcaneus and cuboid.

The *long plantar ligament* is attached proximally to the cuboid, and distally to the bases of the second, third, and fourth metatarsal bones. No short plantar ligament exists.

A fine ligament attaches the cuboid to the lateral extremity of the base of the fifth metatarsal, and another connects it to the third cuneiform.

Navicular Ligaments:—A dorsal ligament runs from the navicular bone to the base of the second metatarsal, and a medial ligament connects it to the first cuneiform.

An interosseous ligament holds the cuboid and cuneiforms in position.

Plantar Metatarsal Ligaments:—The external ligament is an aponeurotic septum attached obliquely to the fourth metatarsal from the outer side of the base across the plantar aspect of the shaft to the head. The adjacent parts of the bases of the third and fourth metatarsals are covered by ligamentous fibres from the sheath of the tendon of the peroneus longus, and representing the termination of the long plantar ligament. This divides into two strands, the external one joining the external ligament, and the internal one passing along the whole length of the third metatarsal as the internal long plantar metatarsal ligament.

Humphry (26) has gone very fully into the shapes of the bones of the foot and the part played by the bones, ligaments, and muscles in its mechanics. He draws attention to the following points:—(1) The shape of the talus throws the weight on the outer

border of the foot; (2) the talus and calcaneus are more for progression than support; (3) the calcaneus easily rolls outwards on its lower surface, so does not act as a bearing surface; (4) the calcaneus is thrown out of the plane of gravity, and it is reduced like its homotype, the pisiform, to a lever for muscles; (5) the talus, navicular, and calcaneo-navicular ligament transmit weight; (6) the posterior surface of the talus slopes downwards and inwards; (7) the action of the calf-muscles on the foot is unfavourable for lifting weight or propelling the body; (8) there is no plantar arch, so the navicular bone with the calcaneo-navicular ligament rest on the ground and do not transmit weight along the arch to the hallux, which is not adapted for support; (9) the mobility of the hallux is obtained by articular, osseous, and muscular arrangements similar to those of the human pollex; (10) there is more power of flexing the digits towards the sole than in Man.

It is, therefore, evident that the joints of the neck, pelvis, wrist, and lower extremity, particularly the latter, differ considerably from those in Man, and all are specialisations in accordance with the mode of locomotion.

The Organs of Digestion.

The loose, thick, fleshy *lips* are projected forwards over the maxillæ. No philtrum is present, and in the living animal only a small part of the red margin of the lower lip is visible when the mouth is closed. Their inner surfaces are studded with the openings of numerous labial salivary glands. The labial frenula are long and narrow. The gape of the mouth is wide. The *cheeks* are loose and mobile, but no pouches exist. The *vestibule* is semilunar, and receives the secretions of Stensen's ducts, which open on papillæ placed as in Man. And a row of papillæ lies beside the salivary papilla on each side (text-fig. 28 C). Rex (**41**) has described the histology of the lips, and Ehlers (**59**) described folds of mucous membrane connecting the gums and cheeks. The *cavum oris* is thrice as long as broad according to Gratiolet (**22**). In my specimen the measurements are:—

Length of hard palate......	2·7 inches.	
Length of soft palate	1·1 ,,	Total = 3·8 inches.
Greatest width of palate...	1·4 ,,	

Much, however, depends on the age of the animal. Keith has shown that the breadth of the palate is greater than the length in new-born animals. The cavity of the mouth has also been mentioned by Symington (**48**) and Tyson (**50**).

The rugæ of the *hard palate* have been figured or described by Beddard (**3**), Bischoff (**60**), Ehlers (**59**), Gratiolet (**22**), Symington (**48**), and Waldeyer (**52**). In my specimen there are no complete ridges crossing the palate, and no incisive papilla. Eleven pairs

of ridges radiate from the median raphé, which is thicker anteriorly than posteriorly. The *soft palate* has the same histological structure as in Man, and its glands are very numerous. Using C. for complete ridges, I. for incomplete ridges, P. for incisive papilla, R. for median raphé, and U. for uvula, the formula is **C**0, **I** 11–11, **P**0, **R**+, **U**+.

In a former paper (**46**) I described the *tongues* of several specimens, and I collected the literature. In this animal there are eight papillæ arranged in a **Y**.

The *pharynx* is as in Man. Faucial and pharyngeal tonsils are both present, and are nourished from the vascular circle formed by the branches of the ascending pharyngeal artery (text-fig. 29). The former is covered by fenestrated mucous membrane. Although lingual, faucial and pharyngeal tonsils are present I was unable to detect Waldeyer's lymphatic ring. Seesel's pocket is absent. The constrictor muscles are as in Man. The sinus of Morgagni is large, and the levatores and tensores palati are more horizontal owing to the prognathism of the skull than in Man.

The *œsophagus* is entirely behind the trachea in the neck. It has similar relations in the neck and thorax to those in Man. The mucous membrane is thrown into prominent longitudinal folds in the cervical and thoracic parts, but the former are more numerous and closer together. The walls are thinner and more dilated in the lower part of the œsophagus. In the upper part the inferior constrictor joins the outer longitudinal muscular coat of the œsophagus, which increases in thickness from above downwards, and becomes continuous with the outer coat of the gastric musculature. The circular muscle coat thickens from above downwards and also becomes continuous with the circular fibres of the stomach. At the lower end of the œsophagus it forms the sphincter of the cardia, which is two inches long. The inner longitudinal fibres in the upper part consist of a few strands, and the submucosa bulges between them; they are entirely absent in the lower part of the œsophagus. Man has only two muscular coats.

Cunningham (**14**) has given a fine illustration of the topographical relations of the abdominal viscera; and anatomical details have been given by a large number of authors, whose works have been collected and grouped by Keith (**29**). So no very full account is given below.

The Stomach.

The œsophagus passes through the diaphragm at the level of the ninth dorsal vertebra, and opens into the stomach after an intra-abdominal course of half an inch. The stomach is divided into fundus, body, antrum, and pylorus. The fundus is well marked and projects up into the left cupola of the diaphragm. The long axis of the stomach is crescentic, and is more horizontal

than in Man. The great curvature reaches a point half an inch below the fourth lumbar vertebra, and the lowest point of the lesser curvature is level with the first lumbar vertebra. Consequently the stomach is U-shaped, and the pylorus is not far from the œsophagus. The pyloric antrum is one and a half inches long, and the pylorus, whose walls are thick, is of the same length. Between the antrum and pylorus there is a slight incisura, and there is a sudden transition from the pylorus to the duodenum. The pylorus does not project like a knob into the duodenum as it does in Man.

The *serous coat* is a uniform covering, united in the usual manner to the omenta. The *muscles* are thin, but three kinds are present. The external longitudinal layer is a complete covering, but it is thicker along the curvatures than on the intermediate parts of the body. The circular fibres are thickest; they are found in the body and pylorus, but only a few run from the œsophagus into the fundus. The oblique fibres are restricted to the fundus and part of the body to the left side of a downward prolongation of the long axis of the œsophagus, and they form rings as in Man. Consequently there are only two muscular layers—an outer one of longitudinal fibres, and an inner one of oblique fibres to the left and circular ones to the right. The *subserous and submucous coats* are thin. The *mucous membrane* is thin, and some of the gastric arteries are seen ramifying in the wall of the stomach. So thin is it that the red injection matter in the vessels shines up prominently against the pale mucosa. It is succulent and its surface shows the areas and glandular orifices as in Man. Only a few longitudinal rugæ are present.

Blood Supply:—The *coronary artery* (text-fig. 40 A) runs along the lesser curvature along with branches of the left vagus nerve; it gives off tortuous gastric arteries to both surfaces (*a.g.a* and *p.g.a*), and œsophageal arteries which pass up through the œsophageal opening in the diaphragm. The parent artery anastomoses with the right gastric branch of the hepatic artery. The *splenic artery* sends branches to the greater curvature (*g.c.b*) and the left gastro-epiploic artery, which anastomoses in the great omentum with the right vessel from the hepatic artery. The *hepatic artery*, in addition to the branches, sends superior pyloro-duodenal arteries downwards, and these meet with inferior pyloro-duodenal branches of the cœliac axis: from both the stomach receives branches. The gastric veins open into the portal system (text-fig. 43). Barkow (2) has given an illustration of the stomach and its vessels.

Nerves:—The left vagus sends branches along the lesser curvature as far as the pylorus, and some other twigs form a plexus over the lower end of the œsophagus. The right vagus sends a rich supply of nerves to the stomach through the splenic plexus and coronary plexus, and directly.

Intestinal Tract.

The *duodenum* begins opposite the first lumbar vertebra, and it is throughout entirely behind the peritoneum. It is divided as in Man into horizontal, descending and ascending parts which measure $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ inches long respectively. There is a well-marked duodeno-jejunal flexure at the level of the first lumbar vertebra. The common bile-duct and pancreatic ducts have a common opening in the descending part, but there is no papilla. No valvulæ conniventes are present, and the villi are small.

The *ileum and jejunum* are 11 feet 5 inches long. Their villi are small. At intervals there are groups of small longitudinal folds of the mucosa. Four Peyer's patches are present at wide intervals in the lower half of the ileum; the lowest, which is also the largest, is 2 inches long and $\frac{3}{4}$ inch broad.

The *vermiform appendix* is $4\frac{1}{2}$ inches long, and the *cæcum* is 3 inches. No appendix valve is present, but the ileo-cæcal orifice is guarded by a shelf valve.

The *colon* is 4 feet long. It is sacculated as usual by two longitudinal muscle bands, and there are many appendices epiploicæ. No Peyer's patches are present. The most capacious part is the sigmoid colon.

The *rectum* and anal canal are $5\frac{1}{2}$ inches long. In the rectum there are eight circular folds, of which the fifth is very prominent, and below it there is a deep pocket on the left side. The anal canal shows numerous strongly-developed vertical folds of mucosa, representing the columns of Morgagni, but there are no traces of the valves of Ball. The entire rectum and anal canal form a straight tube without any trace of the flexures present in Man. Herrmann (**74**) has described the anal mucosa in detail.

The Peritoneum.

The *great omentum* is heavily laden with fat and reaches the symphysis pubis. All four layers are fused and can only be separated at the stomach and transverse colon. The anterior layers are attached to the greater gastric curvature, the first part of the duodenum and spleen, and bands connect it to the lateral abdominal parietes. Between the layers are the usual vessels and lymphatic glands.

The *lesser omentum* is attached as in Man, and the foramen of Winslow is large. It is bulged forwards above the stomach. Between its layers are numerous vessels, sympathetic nerves and lymphatic glands.

No gastro-pancreatic folds are present. The gastro-phrenic, gastro-splenic and lieno-renal ligaments are well-marked. A peritoneal ligament connects the lower pole of the spleen to the transverse colon, and a small accessory spleen is connected to the colon at the same point. A well-marked ligament connects the pylorus to the right ribs, but no suspensory duodenal muscle exists.

The root of the mesentery of the small intestine runs from the left side of the body of the first lumbar vertebra to the right iliac fossa. In the large intestine there is no mesentery to the cæcum, ascending, descending and pelvic colons. The appendix has a mesentery, but no other part has such a long mesentery as the iliac colon. In the rectum the peritoneum is disposed as in Man, being first surrounded by it, and then the peritoneum gradually leaves it till the lower part and the anal canal are quite devoid of a serous investment.

The Salivary Glands.

Many *labial salivary glands* are present.

The *parotid gland* (text-fig. 26) is pyramidal in shape, with the base upwards, immediately below the concha auris. The apex curves round the angle of the mandible and touches the submaxillary gland. The upper part is composed of small lobules, but the lower part is coarse. The capsule is well marked, but no lymphatic glands are included within it. Stensen's duct emerges from the upper part of the gland and its course and relations are as in Man. The relations of the gland to the large vessels and nerves are also as in Man.

The *submaxillary gland* (text-figs. 30 & 31) is flat and triangular and measures one and a half inches in diameter. It is partly under the horizontal ramus of the mandible and partly on the interramal muscles. No strong capsule exists. It is composed of superficial and deep parts, each of which is coarsely lobulated. The duct emerges from the deep surface, runs as in Man, and opens on a frenal lamella beneath the tongue.

The *sublingual gland* (text-figs. 31 and 32) is pyramidal with the apex anterior. Its relations and the course of its duct are as in Man.

Brief accounts of the glands have been given by Tyson (**50**) and Gratiolet (**22**).

The Pancreas.

Bischoff (**60**), Cavanna (**61**), Flower (**20**), Gratiolet (**22**), and Tyson (**50**) have given details of the pancreas. In my specimen it is flat, thin, dark in colour and coarsely lobulated. It has the usual head, body and tail, and it crosses the first lumbar vertebra. An additional process runs up along the portal vein for a short distance; and the pancreatic arteries, which are branches of the splenic, are accompanied by sympathetic nerves. The duct unites with the common bile-duct.

The Liver.

The liver much resembles that in Man. The umbilical fissure is much bridged over, and the fissure of the vena cava is also enclosed. Indications of lateral fissures exist. Near the umbilical region of the right lobe there is a small lobule directed ventrally.

The gall-bladder is superficial and extends beyond the ventral margin of the lobe and it is flexed on itself. In occasional specimens the gall-bladder is deeply embedded in the liver substance. The Spigelian lobe is subquadrate, and the caudate lobe is a triangular cone directed to the right. In some specimens the apex of the caudate lobe reaches the right margin of the liver, but in others it does not do so. The relative sizes of the hepatic lobes may be expressed by Garrod's method thus :—

$$R2 > L > Sp = C.$$

Figures or descriptions of the livers of other specimens, which agree with the above, are given by Bischoff (**60**), Flower (**20**), Barkow (**2**), Gratiolet (**22**), Cavanna (**61**), Symington (**48**), Traill (**49**), Tyson (**50**), and Sperino (**47**).

The relations of the abdominal organs to the vertebræ are different from those in Man, because there are thirteen dorsal vertebræ. The first lumbar vertebra in the Chimpanzee corresponds to the second lumbar vertebra in Man.

Organs of Circulation.

The venous side of the circulation is larger, relatively to the arterial side, than in Man.

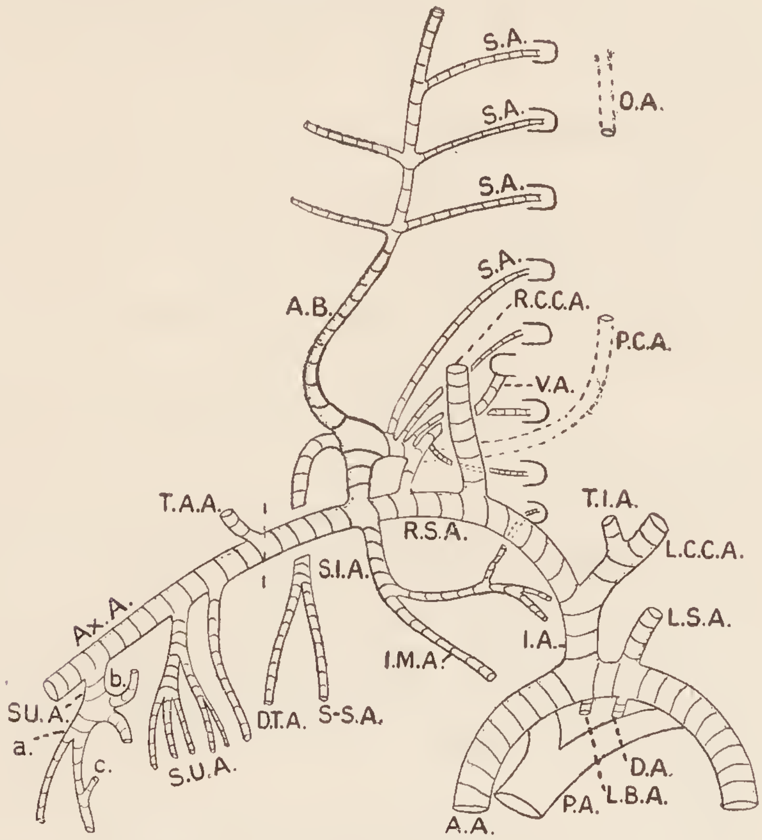
The *pericardium* adheres strongly to the central part of the diaphragm. When it is slit open the finger can explore the aortic arch up to and including the root of the innominate artery, but the reflection of the serous pericardium prevents one touching the left subclavian artery. Only a small part of the pulmonary artery is palpable.

The *heart* is small, measuring 3·2 inches long, 2·3 inches wide, and 1·7 inches antero-posteriorly. The upper border is level with the second costal cartilage, and the apex lies in the fifth intercostal space. Fat is present on the base and apex. Its internal structure is very similar to that in Man. The position and relations have been recorded or figured by Cunningham (**13**) and Ruge (**43**), and details of its construction have been given by Bischoff (**60**), Cavanna (**61**), Ehlers (**59**), Dwight (**18**), Gratiolet (**22**), Tyson (**50**), and Traill (**49**). The apex is entirely formed by the thick, muscular left ventricle, and this differs entirely from the condition which I have already described and figured in *Mandrillus* (**62**).

The pulse of a young male Chimpanzee, whose age would make it correspond to the young child, was 150 per minute. It was regular in rate and rhythm; it was full, and the rise and fall were moderately rapid. No dicrotism was present. The apex was not very sustained. It could easily be felt on the radial aspect of the lower end of the forearm because the radial artery is very superficial. Owing to the inability to listen to the hearts of the larger specimens in the Gardens I am unable to describe the relation between age and heart rate. The heart sounds were as in Man. The blood pressure was not obtainable.

The *aortic arch* (text-fig. 38, A.A) describes a small curve and gives way to the descending aorta at the sixth dorsal vertebra. Its relations are as in Man. It gives off the innominate and left subclavian arteries from its convexity, and the main bronchial artery to the left lung (L.B. A) arises from its concavity. The *innominate artery* (I.A), a large vessel about 2 cm. long, gives off the *left common carotid* (L.C.C.A) and divides behind the right half of the manubrium sterni into the *right common carotid* (R.C.C.A) and *right subclavian* (R.S.A) arteries. The left common carotid gives off the *thyroidea ima* (T.I.A) close to its origin. The intrathoracic parts of the left common carotid and *left subclavian* arteries are mostly as in Man, but the latter is relatively larger and not so vertical.

Text-figure 38.



The main arteries of the thorax and pectoral extremity. Ax.A : axillary artery; O.A : occipital artery; SU.A : subscapular arteries. Other letters in text.

The *pulmonary artery* (text-fig. 38, P.A) is much more capacious than in Man, and its left branch is united to the aortic arch by a wide, open, ductus arteriosus (D.A). The presence of the latter, and the origin of the left bronchial artery are of interest from the embryological point of view, but the foramen ovale is closed and the venæ cavæ are normal.

The ductus arteriosus is the sixth embryonic arterial arch, and the bronchial artery coming from the concavity of the aortic arch possibly represents the remains of one of the vessels connecting the outer extremities of the embryonic arches. So we have in this animal a combination of interesting embryological conditions persisting.

As the pulmonary artery is much wider than that in Man, the velocity and pressure of the blood in it must be relatively less than in him, as can be shown by applying the laws of velocity and pressure.

The *descending thoracic aorta* extends from the sixth to eleventh dorsal vertebræ after which it passes into the abdomen. It gives off the intercostal arteries to the lower ten intercostal spaces, a small bronchial artery to the left lung, a large bronchial artery to the right lung, and several branches to the thoracic œsophagus, which anastomose with œsophageal branches of the cœliac axis. The lower intercostal arteries supply the diaphragm.

The *abdominal aorta* extends from the twelfth dorsal vertebra to the lower border of the fourth lumbar vertebra, where it divides into the two common iliac arteries. It is relatively smaller, and its branches are fewer than in Man. The following is the order of the branches from above downwards:—

1. Phrenic artery.
2. Cœliac axis.
3. Superior mesenteric artery.
4. Renal arteries.
5. Right ovarian artery.
6. Inferior mesenteric artery.
7. Four lumbar arteries arising at different levels from the back of the aorta.

It does not give off any suprarenal arteries, nor is it continued as a middle sacral artery.

The *phrenic artery* is a large vessel arising from the left side of the beginning of the abdominal aorta. It gives a small branch to the left crus and left half of the diaphragm, and it is continued over the right crus as a large vessel which sends branches to the central tendon, the muscle fibres, the right crus, the process arising from the second lumbar transverse process and the right suprarenal capsule.

Blood Supply to the Suprarenal Capsules:—Each capsule receives a vessel from the phrenic artery and the corresponding renal artery, but none from the aorta.

The *Cœliac Axis* (text-fig. 40, C.Ax) arises immediately above the upper border of the pancreas, and it quickly divides into hepatic, coronary, splenic, and inferior pyloro-duodenal arteries. Of these the hepatic is by far the largest.

The *Hepatic Artery* (H.A) first runs to the right and then turns upwards to the liver. Between the layers of the gastro-hepatic omentum it divides into two branches; and it lies in front of the portal vein, and to the left side of the common bile-duct. One of the two terminal branches (*a*) runs straight to the liver and divides into two arteries which enter the portal fissure. The other branch (*b*) runs in a convoluted course to the right, gives off the cystic artery (*c.a*) to the gall-bladder and divides into two arteries which sink into the right and left lobes of the liver.

The artery gives off a trunk which divides into:—

1. *Right gastric artery* (*r.g.a*), which anastomoses with the left gastric artery on the lesser gastric curvature.
2. *Pyloro-duodenal vessels* (*p.d.v*), which anastomose with the inferior pyloro-duodenal artery.
3. *Right gastro-epiploic artery* (*r.g.e.a*), which anastomoses with branches of the splenic artery in the great omentum.

The *Coronary Artery* (C.A) is continued through the œsophagus as the œsophageal artery (*o.a*). Branches arising from its lateral side are:—

1. *Anterior gastric arteries* (*a.g.a*) to the anterior wall of the stomach in the fundus and body.
2. *Posterior gastric arteries* (*p.g.a*) to the posterior wall of the stomach in the fundus and body.
3. *Left gastric artery* (*l.g.a*), in the lesser omentum, anastomoses with the right gastric artery.

The *Inferior Pyloro-duodenal Artery* (I.P.D.A) anastomoses with branches of the hepatic and superior mesenteric arteries.

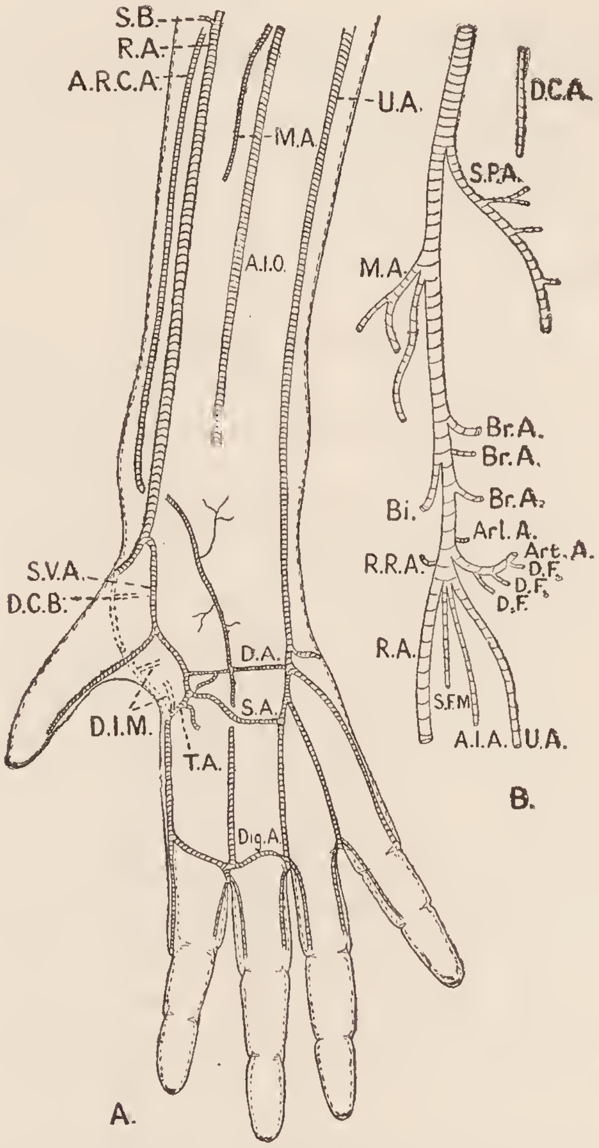
The *Splenic Artery* (S.A) runs infero-laterally and divides into two terminal splenic vessels. It gives off branches to the stomach (*g.b*) and several vessels which form the left gastro-epiploic artery (*l.g.e.a*) which anastomoses with the right artery. It is much smaller than the hepatic artery.

The *Superior Mesenteric Artery* (text-fig. 40 B) sweeps downwards into the right iliac fossa. It supplies the duodenum, jejunum, ileum, and large intestine as far as the right third of the transverse colon. It divides into two main branches. The trunk of the artery and left branch (*l.b*) supply the small intestine from the duodenum to the junction of the middle and lower thirds of the ileum, the vessels for these parts coming off close together. The highest branch anastomoses with the inferior pancreatico-duodenal branch of the cœliac axis, and the lowest one anastomoses with the highest branch of the other half of the superior mesenteric artery. The trunk of the artery gives off a branch (*b*) which bifurcates; the one half anastomoses with the lower branch of the parent stem, and its other half anastomoses in the transverse meso-colon with the middle colic branch of the inferior mesenteric artery. The arterial arcades in the mesentery are not numerous. Many glands and sympathetic nerves are mixed with the vessels.

The *Inferior Mesenteric Artery* (text-fig. 40 C) arises from the front of the abdominal aorta about three-quarters of an inch above its bifurcation. It runs downwards for half an inch and divides into two vessels which subdivide into large bundles of vessels for the iliac and pelvic colons. These vessels anastomose with one another. The parent artery gives off a large vessel, which divides into middle and left colic arteries, and the latter divides into ascending and descending branches. The *mid colic*

artery (M.C.A) supplies the left part of the transverse colon and the hepatic flexure. It anastomoses with the right colic branch of the superior mesenteric artery, and the ascending branch of the left colic artery. The *left colic artery* (L.C.A), supplying the descending colon, anastomoses with the mid colic artery and branches to the iliac colon. The *superior hæmorrhoidal artery* (S.H.A), from the right division of the parent artery, goes down to the pelvis to supply the rectum and anus. It is relatively

Text-figure 39.



The arterial supply to the pectoral extremity. A: arteries of the forearm and hand; B: arteries of the arm; A.I.O and A.I.A: anterior interosseous artery; D.C: descending branch of the circumflex arteries; M.A: median artery. Other letters in text.

larger than in Man, and replaces branches of the hypogastric artery. It divides into two terminal branches; the anterior supplies the rectum and anus, and the posterior one is limited to the rectum.

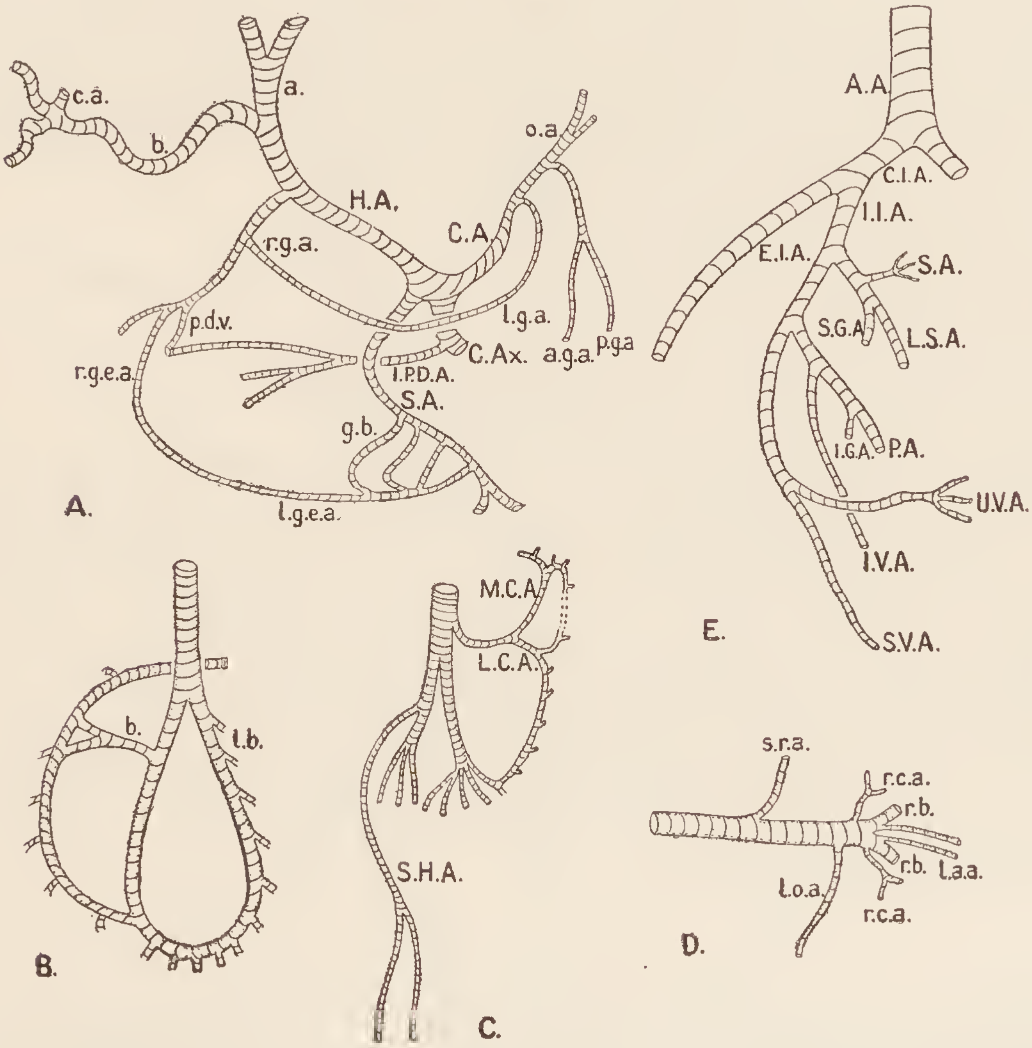
Renal Arteries:—The left vessel (text-fig. 40 D) gives off supra-renal arteries (*s.r.a*), branches to the renal capsule (*r.c.a*), two small arteries which anastomose with the lumbar arteries (*l.a.a*) and the left ovarian artery (*l.o.a*). It ends by dividing into two

vessels to the kidney. The right renal artery gives off renal, suprarenal and capsular vessels, but no parietal nor ovarian arteries.

Ovarian Arteries:—The left one comes from the left renal artery, but the right one springs from the aorta. Both run as in Man, and their terminal parts are convoluted.

Lumbar Arteries:—Four single arteries arise from the back of the aorta. The highest is level with the cœliac axis, the second is just below the renal arteries, the third is level with the third

Text-figure 40.



Arteries of the abdomen and pelvis. A: cœliac axis; B: superior mesenteric artery; C: inferior mesenteric artery; D: left renal artery; E: iliac arteries; C.I.A: common iliac artery; E.I.A: external iliac artery; I.I.A: internal iliac or hypogastric artery; *r.b*: arterial branches to the kidneys. Other letters in text.

lumbar vertebra, and the fourth is at the fourth vertebra. These bifurcate, and the halves run like the lumbar arteries in Man.

The *common iliac arteries* diverge for one and a half inches from the aorta, along the pelvic brim, and each gives off the hypogastric artery and is continued as the external iliac artery. The left vessel is the more vertical.

The *external iliac arteries* give no branches, but those which

arise from them in Man are here replaced by branches of the last lumbar and femoral arteries. The relations are as in Man.

The *hypogastric artery* (text-fig. 40 E) on each side divides as in Man into anterior and posterior divisions. The anterior division gives off:—

1. A trunk which divides into superior vesical (S.V.A) and uteri-vaginal (U-V.A) arteries. The former is a small vessel, which reaches the side of the bladder up which it runs to the fundus. The latter is larger and breaks up into vessels supplying the uterus and vagina; details are given on p. 401.

2. The *Pudendal Artery* (P.A) gives off the inferior vesical artery (I.V.A), passes through the great sciatic notch at the lower border of the pyriformis and, after giving off the inferior gluteal artery (I.G.A), it breaks up into branches which pass through the ischio-rectal fossa to the rectum and anus, the vagina, the levator ani and sphincter vaginæ.

The posterior division gives off:—

1. A bundle of arteries which enter the anterior sacral foramina (S.A.).
2. Lateral sacral artery (L.S.A).
3. Superior gluteal artery (S.G.A).

The *superior gluteal artery* emerges at the upper border of the pyriformis and supplies it. It divides into two main branches. The upper one supplies the gluteus medius and gives the nutrient artery to the ilium. The lower one descends to supply the gluteus medius, gluteus minimus, and scansorius.

The *inferior gluteal artery* emerges with the pudendal artery at the lower border of the pyriformis. It gives branches to the gluteus maximus, gemellus superior, obturator internus, scansorius, and acetabular part of the ilium. It anastomoses with the lateral circumflex artery.

Arteries of the Head and Neck.

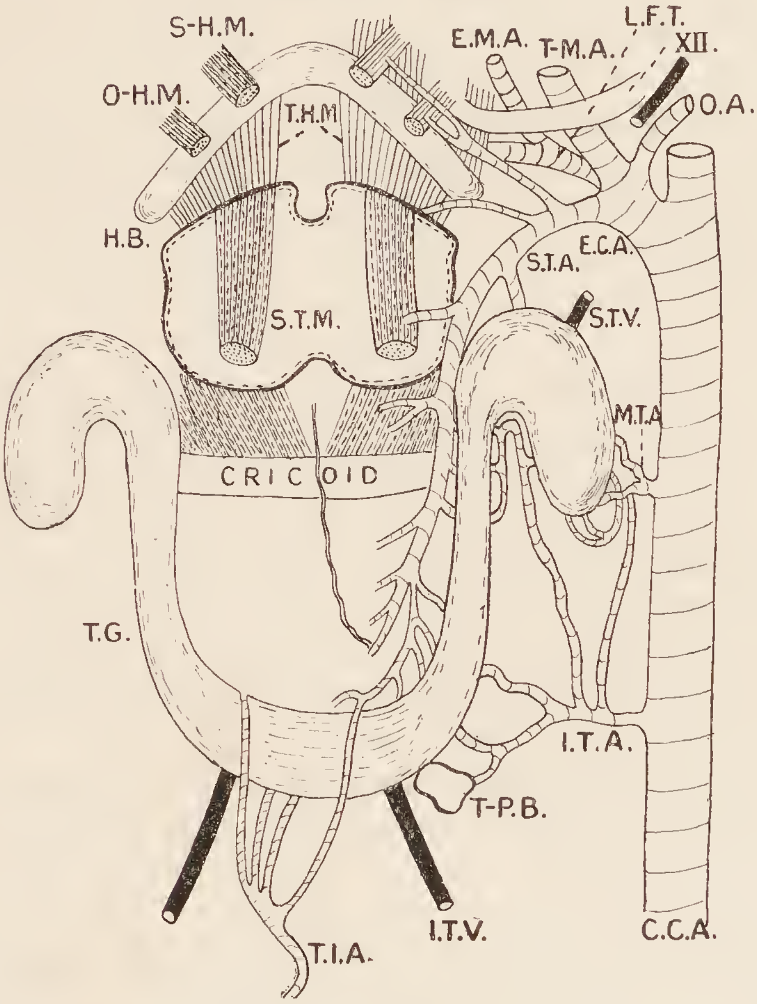
The *common carotid arteries* (text-fig. 41, C.C.A) extend from the sterno-clavicular articulations to the upper border of the lateral aspects of the thyroid cartilage, where they divide into external and internal carotids. They are concealed by the large external jugular veins, and they line in front of the vagus and sympathetic nerves. But no internal jugular veins are present to form lateral relations. No carotid sheath exists. The other relations are as in Man. It gives off tortuous inferior and middle thyroid arteries (text-fig. 41, I.T.A. and M.T.A), which replace the inferior thyroid branch of the subclavian arteries. This may be an individual peculiarity.

The *external carotid artery* (E.C.A) first ascends almost vertically till it reaches the level of the hyoid bone, where it inclines posteriorly and upwards, being continued as the temporo-maxillary artery. Within the parotid gland it divides into

internal maxillary, superficial temporal, and transverse facial arteries. The branches run in different directions. Coursing mesially are the superior thyroid (S.T.A), a combined lingual and external maxillary trunk (L.F.T), transverse facial and internal maxillary arteries. Running laterally is the occipital artery (O.A.), and vertically the superficial temporal, ascending pharyngeal and parotid arteries.

The *superior thyroid artery* (text-fig. 41, S.T.A) arises almost at the beginning of the external carotid. It describes the usual

Text-figure 41.



The larynx, thyroid gland and vessels of the neck. H.B : hyoid bone; O-H.M : omo-hyoid muscle; S-H.M : sterno-hyoid muscle; S.T.M : sterno-thyroid muscle; T.G : thyroid gland; T.H.M : thyro-hyoid muscles; T-M.A : temporo-maxillary artery; T-P.B : thymus and parathyroid; XII : hypoglossal nerve. Other letters in text.

curve, with its convexity upwards, and then descends along the greater part of the mesial border of the lateral thyroid lobe. It terminates by anastomosing with the thyroidea ima (T.I.A). It gives off mesial branches to the omo-hyoid, sterno-hyoid, sterno-thyroid, crico-thyroid and thyro-hyoid muscles; and a branch enters the larynx through the thyro-hyoid interval. The lateral branches supply the thyroid gland and anastomose with branches of the middle thyroid artery. The corresponding superior thyroid vein enters the anterior facial vein. The

combined linguo-facial artery (L.F.T) is given off at the point where the external carotid changes its direction. After an upward and forward course of half an inch it divides into lingual and external maxillary arteries.

The *lingual artery* runs horizontally and disappears under cover of the hyo-glossus muscle after giving off a large branch to the submaxillary gland. It then courses between the hyo-glossus and middle constrictor of the pharynx; and in this situation it gives off supra-hyoid and muscular arteries. Emerging from under the anterior border of the hyo-glossus, it passes forwards and dips downwards between the stylo-glossus and sublingual gland laterally and the genio-glossus mesially. It sinks into the latter, and can be traced to a communication with its neighbour below the apex of the tongue.

The *external maxillary artery* (text-fig. 41, E.M.A) runs first forwards and upwards on the upper surface of the submaxillary gland, then between the gland and the mandible. At the anterior border of the masseter it crosses on to the outer surface of the mandible and gets into the face (text-fig. 26). There it runs in a curved, but not convoluted, course to the angle of the mouth, where it becomes more vertical; and it ends in the levator anguli oris. It is concealed by the platysma and zygomatic mass, and it lies on the surface of quadratus labii superioris and buccinator. It gives off several branches to the outer surface of the submaxillary gland (S.M.G). In the face (text-fig. 26) it gives off masseteric (M.A.S), inferior labial (I.L.A), inferior coronary (I.C.A), and superior labial (S.L.A) vessels, whose distributions are shown in the figure. The submaxillary branches send vessels to the mylohyoid.

The *transverse facial artery* (text-fig. 28) runs forwards between the parotid and masseter, supplying both, and then along the zygoma.

The *internal maxillary artery* (text-fig. 29 A) has the same course as in Man, but it lies on the surface of the external pterygoid. It gives off the following branches:—

A. *In the Pterygoid Region*:—

1. Numerous pterygoid branches to the muscles, especially to the insertion of the external pterygoid.
2. Inferior dental artery (I.D.A) which runs as in Man along with the inferior dental nerve.
3. Meningeal artery (M.A) which passes deep to the external pterygoid, and divides into middle and accessory arteries, which enter the skull as in Man.
4. Buccal artery (B.A) accompanying the long buccal nerve.
5. Fine arteries to the suctorial pad of fat (S.P.F).
6. Posterior superior dental (P.S.D) to the gums round the molar teeth.
7. Two large, deep temporal arteries (D.T.A) which run up in the substance of the temporal muscle and anastomose freely.

B. *In the Pterygo-maxillary Region* :—

1. Infra-orbital artery, which passes forwards to the face. It supplies the incisor and canine teeth, some of the muscles of the face, and the upper lip.

2. Descending palatine artery to the soft palate, gums and mucous membrane of the mouth.

3. Pterygo-palatine artery to the roof of the pharynx, sphenoidal sinus, roof of the nose, and the Eustachian tube.

4. Spheno-palatine to the roof and outer wall of the nose, the ethmoidal cells, sphenoidal sinus, and pharnyx.

The *Ophthalmic Artery*, which continues the internal carotid artery beyond the carotid canal is, except for its size, similar to that in Man in every way.

The *superficial temporal artery* (text-fig. 26, S.Te.A) is the apparent continuation of the external carotid artery. It runs upwards accompanied by the corresponding vein and the auriculo-temporal nerve. It divides into two branches which supply the scalp from the supra-orbital crest anteriorly to the occipital crest posteriorly.

The *transverse facial artery* (text-fig. 28, T.F.A) runs forwards between the parotid gland superficially, and the masseter deeply, supplying both by large branches. It is continued by a small artery along the surface of the zygoma.

The *occipital artery* arises from the lateral aspect of the external carotid soon after its origin. It passes upwards and backwards, and under the cleido-mastoid it gives off the *posterior auricular artery*, which supplies the parotid gland and back of the auricle. The parent stem then curves downwards and disappears under the lateral border of the splenius capitis. Under the splenius it gives off a descending branch which passes downwards among the muscles of the neck and supplies them by small twigs. The parent vessel then passes onwards under the complexus, and supplies it and the muscles bounding the sub-occipital triangle. It does not end in the scalp, nor is the terminal part crossed by the sub-occipital nerve as in Man.

The branches, with the exception of the posterior auricular artery, are distributed entirely to the muscles. No meningeal arteries run from it through the anterior condyloid foramen as in Man.

The *ascending pharyngeal artery* (text-fig. 29 B), from the back of the beginning of the external carotid runs upwards and supplies the pharynx, levator palati, tensor palati, and pre-vertebral muscles. It passes deep to the common carotid artery, and enters the jugular foramen behind the nerves. It gives off branches which form an arterial circle supplying the tonsils and pharynx.

The *internal carotid artery* is as in Man. It is accompanied by several twigs from the superior cervical sympathetic ganglion.

Arteries of the Pectoral Extremity.

Subclavian Arteries (text-fig. 38, R.S.A. and L.S.A):—The branches of the extra-thoracic parts differ from those in Man, but the parent vessels are similar, though relatively larger. The branches are:—

1. *Vertebral Artery* (V.A) which is very large. It enters the foramen in the sixth cervical vertebra along with sympathetic nerves from the inferior cervical ganglion of the sympathetic.

2. A large trunk whose branches correspond to separate branches of the human subclavian. Its first set of branches, which arise together, are:—

a. Spinal Arteries (S.A) entering the lower four intervertebral foramina behind the corresponding nerves.

b. Profunda cervicis (P.C.A) which passes between the transverse process of the seventh cervical vertebra and the neck of the first rib. It ascends among the muscles of the back of the neck, supplies them, and anastomoses with the occipital artery.

c. Muscular branches to the prevertebral muscles.

The trunk then runs outwards, gives off an *ascending branch* (A.B) to the muscles in the floor of the posterior triangle and the upper four spinal foramina and the long thoracic artery (L.T.A). Finally it divides into the *suprascapular artery* (S-S.A), and a branch corresponding to the *descending branch of the transverse cervical artery* in Man (D.T.A). These terminal branches course much as in Man.

No inferior thyroid artery is present, its place being taken by a branch of the common carotid artery.

3. *Prevertebral muscular artery.*

4. *Superior intercostal artery* (S.I.A) is large. It runs over the neck of the first rib, gives very small branches to the first two interspaces, and is continued as a very large artery into the first thoracic intervertebral foramen.

5. The *internal mammary artery* (I.M.A.) arises close to the inner border of the scalenus anticus along with the superior intercostal artery, and its relations are as in Man. It divides at the fifth interspace into superior epigastric and musculo-phrenic. It gives off an artery which breaks up into branches to the thymus, pericardium, and mediastinum, and anastomoses with the thyroidea ima. Muscular branches run to the triangularis sterni. But the intercostal arteries are not as regularly disposed as in Man. The *phrenic artery* divides into two at the seventh chondro-costal junction; one branch turns inwards and enters the diaphragmatic musculature, and the other continues along the origin of the diaphragm to the mid-axillary line where it enters the diaphragm. It anastomoses with phrenic branches of the lower intercostal arteries.

Branches of the suprascapular and descending branch of the transverse cervical arteries take the place of the superior thoracic

branch of the axillary artery in Man. No branches come from the second and third parts of the subclavian.

The *Axillary Artery* has the same course and relations as in Man. It has the additional deep relation to the axillary prolongation of the air sac. It gives off the following branches:—

1. *Thoracico-acromial axis* (T.A.A), which is not so complex as in Man. It supplies the pectoralis major, deltoid, and the fat and lymph glands in the axilla.

2. A *muscular artery* supplying twigs to the subscapularis.

3. The *subscapular artery* (S.U.A) gives off branches which arise separately in Man. These are:—*a.* A branch which runs to the inferior angle of the scapula between the teres major and latissimus dorsi, and supplies the latter; *b.* A humeral trunk, which divides into the anterior and posterior circumflex arteries. These form an anastomosis round the neck of the humerus, and the posterior circumflex gives a descending branch, which anastomoses with the profunda branch of the brachial artery; *c.* artery to the teres major; the main stem then runs down the axillary border of the subscapularis, and ends in the infraspinatus at the inferior angle of the scapula. Its circumflex branch supplies the infraspinatus, passes through the great scapular notch, and ends in the supraspinatus. There is no marked anastomosis round the scapula as there is in Man.

The *Brachial Artery* (text-fig. 39 B) differs from that in Man. It becomes the ulnar artery three inches below the internal humeral condyle. It lies superficial to the median nerve throughout, as in the Cercopithecidæ. Its branches are:—

1. *Superior Profunda* (S.P.A) divides into two branches, which embrace the musculo-spiral nerve. One branch follows the nerve, anastomoses with the descending branch of the posterior circumflex artery, supplies the triceps and ends in it. An ascending twig ends in the latissimus dorsi. The other branch curves mesially round the humerus, and supplies the deltoid and triceps.

2. A large artery (M.A) to the biceps, brachialis anticus, and triceps.

3. Three muscular arteries to the brachialis anticus (Br.A).

4. Two muscular arteries to the biceps (Bi).

5. *Articular* to the elbow joint (Art.A).

6. *Radial artery* (R.A).

7. A muscular artery to the triceps and muscles arising from the external supracondylar ridge and external epicondyle (Arl.A).

8. *Articular artery* to the elbow joint.

9. Muscular arteries to the deep flexors and extensors (D.F).

10. *Radial recurrent artery* (R.R.A).

11. Muscular to the superficial flexor muscles (S.F.M).

12. *Anterior interosseous artery* (A.I.A).

There is no anastomosis round the elbow joint as there is in Man.

The *Radial Artery* (text-fig. 39 A), which is the largest vessel in the forearm, runs down the forearm very superficially, curves round the back of the wrist and over the trapezium, and passes into the first interosseous space, so it is divisible into three parts as in Man. The first part, lying in the forearm, gives off the following branches:—1. A large muscular artery to the supinator brevis (S.B); 2. Numerous fine twigs to the superficial flexor muscles; 3. *Anterior radial carpal artery* (A.R.C.A), which arises in the upper third of the forearm, runs down parallel to the radial artery, and crosses behind it in the lower part of the forearm. It ends by a series of arteries over the palmar ligaments of the inferior radio-ulnar, radio-carpal, intercarpal, and carpo-metacarpal joints. It also supplies the flexor muscles; 4. *Superficialis volæ* (S.V.A) runs downwards and inwards across the thenar eminence and supplies its muscles. And it is continued along the inner border of the pollex. It gives off a fine twig which curves inwards and helps to form the irregular superficial palmar arch. The second part of the artery, lying on the trapezium, gives off twigs to the dorsal aspect of the intercarpal joints (D.C.B), and a muscular artery to the first dorsal interosseous muscle (D.I.M). From the dorsal carpal branch there rises a vessel to the adjacent sides of the dorsal aspect of the index and medius. The third part of the artery lies in the interval between the palmar aspects of the index and pollex. It gives off a thenar artery (T.A) to the thenar muscles, a muscular artery to the first dorsal interosseous muscle (D.I.M), several adductor twigs and branches to the lumbricales. Over the heads of the metacarpal bones it gives a branch to the radial side of the index finger.

The *Ulnar Artery* (text-fig. 39 B, U.A) runs downwards as in Man, curves round the mesial aspect of the pisiform bone and enters the palm. It bifurcates about the middle of the palm. One branch runs to the inner border of the minimus; and the second divides into two branches which supply respectively, the adjacent sides of the minimus and annularis, and annularis and medius. From the latter branch, two arteries pass to join with branches of the radial artery and form the superficial and deep palmar arches. As the artery turns round the pisiform it gives off a dorsal branch which curves round the ulnar border of the manus to supply the tissues on the back of the ulnar border of the carpus.

The *anterior interosseous artery* (text-fig. 39 B, A.I.A) is as in Man.

Three *palmar arterial arches* are present (text-fig. 39 A):—(1) The deep arch (D.A), lying in front of the carpus, is formed by a branch of the ulnar artery, the superficialis volæ, and the branch of the radial artery to the thenar eminence; (2) the superficial arch (S.A), lying in the front of the deep arch, is

formed by the superficialis volæ and a branch of the ulnar artery; (3) a digital arch (Dig.A) over the metacarpo-phalangeal joints of the index and medius is formed by a branch of the ulnar artery with the continuation of the radial artery. The deep and digital arches are connected by a thick vessel.

The wrist joint is supplied by dorsal branches of the radial and ulnar arteries, the anterior radial carpal artery, the anterior interosseous artery, and the deep palmar arch. There is no anastomosis round the elbow joint.

The arrangements of the arteries in the pectoral extremity favour a relatively slower circulation than in Man. The profunda arteries break up into a much larger number of branches, and the brachial artery terminates in a large number of vessels which run distally in long, parallel trunks. Consequently the frictional resistance resulting from more numerous branches, combined with the relatively smaller and more uniform brachial artery slow the circulation much more. The addition of a third, or digital, arterial arch is an additional factor. As there are no anastomoses round the joints and scapula, the connections must be more numerous in the muscles, which will consequently play an important part in maintaining the circulation. And finally, the vascular arrangements are such that the head, neck, and arm get a relatively greater supply of blood than do the thorax, abdomen, and legs.

Arteries of the Pelvic Extremity.

The *femoral artery* begins about the middle of Poupart's ligament and courses downwards for an inch and a half. Then it gives off the profunda and is continued as the superficial femoral artery. The latter passes between the two parts of the adductor magnus and becomes the popliteal artery. There is no adductor canal. The common femoral artery gives off a trunk which divides into an abdominal artery and the mesial circumflex artery; and the former, after giving a nutrient artery to the ilium and the deep epigastric, is continued as the obturator artery. From the common femoral artery the deep circumflex iliac artery also arises. The profunda gives off the lateral femoral circumflex artery, and the superficial femoral artery gives off the saphenous artery, which goes down to the foot.

The *deep epigastric artery* runs up in the sheath of the rectus, but does not anastomose with a superficial epigastric branch of the internal mammary artery.

The *obturator artery* passes through the obturator foramen after running down over the horizontal ramus and back of the pubis. It supplies the symphysis pubis and muscles attached to the bone around the foramen.

The *mesial femoral circumflex artery* runs down over the head of the femur under the adductor muscles, and supplies the capsule of the hip joint, psoas, obturator internus, and adductor

magnus. It then passes round to the back of the leg and gives branches to the adductor magnus, quadratus femoris, biceps, and gluteus maximus: it also gives off the *arteria comes nervi ischiadici*.

The *deep circumflex iliac artery* runs up to the ilium. It supplies the sartorius and ilio-psoas, and ends between the internal oblique and transversalis abdominis.

The *profunda femoris* gives off the lateral circumflex and a branch passing back under the rectus femoris to the gluteus medius. It then passes through the middle head of the adductor magnus, supplies the adductor longus and vasti, and ends in the biceps. There is no series of perforating arteries as in Man.

The *lateral femoral circumflex artery* gives off:—1. an ascending branch to the glutei, rectus femoris, and hip joint: 2. a transverse artery to the gluteus maximus, vastus externus, and hip joint; 3. a descending artery to the rectus femoris, vastus externus, crureus, and hip joint.

The *popliteal artery* gives off muscular twigs to the heads of the gastrocnemius, an articular artery to the knee and a genicular trunk, the latter dividing into three branches:—1. a lateral geniculate artery which gives a nutrient artery to the femur, a branch to the back of the joint and one which passes round to the front of the capsule; 2. a mesial genicular artery which supplies the capsule in the popliteal space; 3. a descending artery which supplies the popliteus and passes through between the tibia and fibula to the anterior tibial muscles.

The *posterior tibial artery* continues the popliteal. It gives off a recurrent branch which anastomoses with the geniculars. A long branch, corresponding to the human anterior tibial artery, descends to the lower end of the posterior tibial region and curves forwards to the anterior tibial region; it gives off the following branches:—1. an artery which anastomoses with the saphenous artery and helps to form the arterial arcade on the dorsum of the foot; 2. muscular arteries; 3. malleolar arteries; 4. nutrient artery to the fibula; 5. articular arteries to the ankle. The arterial arch on the dorsum gives digital arteries to all toes except the hallux. The saphenous artery, after forming the arterial arcade, supplies the tarsal joints and gives an artery which replaces the dorsalis pedis in Man. This dips in between the hallux and first toe and gives a branch to the lateral side of the hallux and several muscular arteries. It then passes between the heads of the adductor hallucis and anastomoses with the deep branch of the lateral plantar artery to form the plantar arch. The latter vessel is the terminal branch of the posterior tibial artery.

The posterior tibial artery divides under the laciniate ligament into medial and lateral plantar arteries. The *lateral plantar artery* gives off the lateral calcanean artery to the skin of the heel and branches to the flexor brevis digitorum, accessorius, and abductor minimi digiti. It then divides into superficial

and deep divisions. The former continues as digital branches to the outer two digits; the latter passes between the heads of adductor hallucis and supplies the interossei, tarso-metatarsal joints, and anastomoses with the vessel corresponding to the dorsalis pedis to form the plantar arterial arch. The *medial plantar artery* gives off medial calcanean branches to the skin of the inner side of the sole of the foot and muscular branches to the abductor hallucis and flexor brevis hallucis and digital arteries to the inner three toes.

Veins of the Thorax.

Innominate Veins (text-fig. 42 B):—The left vein runs as in Man and unites with the more vertical right one to form the superior vena cava. It receives inferior thyroid (I.T.V), thymic (T.V), internal mammary (I.M.V) and superior intercostal (L.I.V) veins. The short right vein only receives the formative vessels.

The *superior vena cava* (S.V.C) is large, vertical, and enters the upper part of the right auricular appendix. It receives the vena azygos major as in Man. The thoracic part of the *inferior vena cava* is 2·6 cm. long.

The *azygos veins* drain the lower nine spaces, the first three being drained by the superior intercostal vein. All are small. No ascending lumbar veins were found. The vena azygos major enters the superior vena cava at the level of the fifth dorsal vertebra.

Veins of the Head and Neck (text-fig. 42 A).

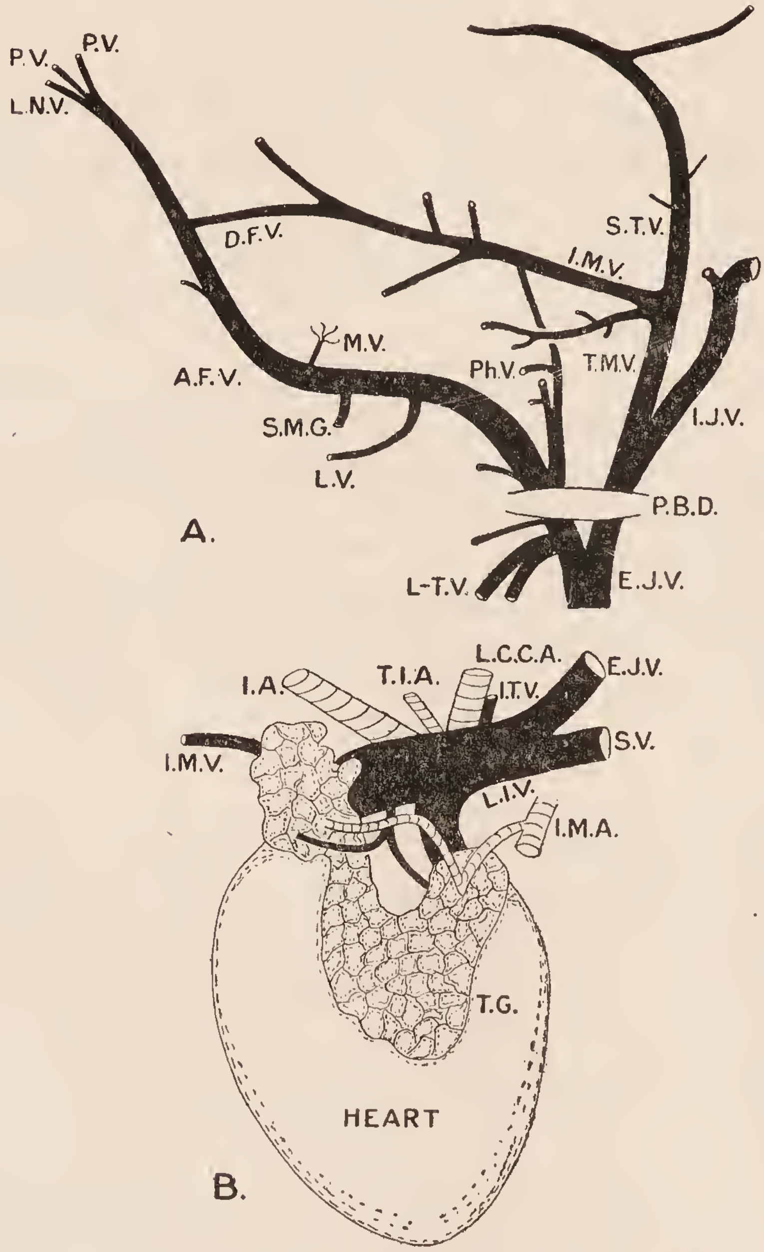
The *intra-cranial blood sinuses* have the same general arrangement as in Man. The chief difference lies in the union of the inferior petrosal and lateral sinuses within the jugular foramen to form the internal jugular vein. The groove in the skull for the right lateral sinus is much larger than that for the left, and a very shallow bony groove connects the two.

The *anterior facial vein* (A.F.V) begins by the confluence of palpebral and lateral nasal veins. It runs downwards and backwards and crosses the mandible at the anterior border of the masseter. It crosses the levator anguli oris and buccinator, and it is covered by the zygomaticus, risorius, and platysma. It runs between the mandible and sub-maxillary gland, and then under the stylo-hyoid and posterior belly of the digastric. Finally it unites with the temporo-maxillary vein to form the external jugular vein. It receives the following tributaries:—(1) *Palpebral veins* (P.V) from both eyelids. (2) *Lateral nasal veins* (L.N.V). (3) *Masseteric veins* (M.V). (4) *Deep facial vein* (D.F.V), which runs under the malar bone and buccal pad of fat to the pterygoid region. (5) *Submaxillary glandular vein* (S.M.G). (6) *Lingual vein* (L.V). (7) *Laryngeal and superior*

thyroid venous trunk (L-T.V). (8) *Pharyngeal veins* (Ph.V). No vena transversa exists.

The *temporo-maxillary vein* (T-M.V) is formed within the parotid gland by the union of the internal maxillary (I.M.V) and superficial temporal (S.T.V) veins. It drains the side of the head and pterygoid region and parotid gland. It receives the very short *internal jugular vein* (I.J.V), passes under the

Text-figure 42.



The cephalic veins (A) and thoracic thymus gland (B). L.I.V: superior intercostal vein ascending from behind the heart to enter the innominate vein; P.B.D: posterior belly of the digastric muscle; T.G: thymus gland (the small veins and arteries on its surface are the thymic vessels, described in the text as T.V.). Other letters in text.

posterior belly of the digastric and stylo-hyoid muscles and unites with the anterior facial vein to form the external jugular vein. The vein shows no trace of a division. No jugular bulb is present on the internal jugular vein.

It has been shown on p. 330 that there is no close pterygoid plexus, and the pharyngeal veins do not form a rich plexus.

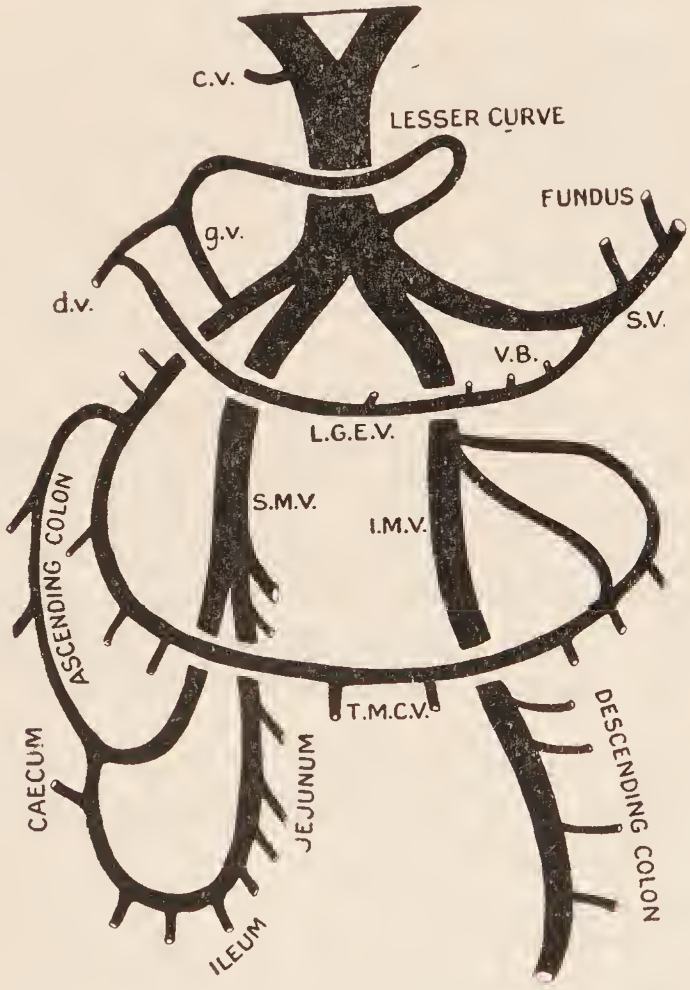
The *external jugular vein* (E.J.V) does not lie on the surface of the sterno-mastoid. It dips down and lies on the surface of the common carotid artery, vagus and sympathetic. At the outer border of the first rib it unites with the subclavian vein to form the innominate vein.

Veins of the Abdomen.

The Portal System (text-fig. 43).

The general arrangement of the tributaries of the portal system is the same as in Man, but there are differences in detail. The vein formed by the confluence of gastric, splenic and inferior mesenteric veins unites with a large trunk formed by pyloro-duodenal, superior mesenteric veins and the veins from the

Text-figure 43.



The portal vein. Letters in text.

transverse colon to form the portal vein. And the veins from the transverse colon form a connecting loop between the two systems. The portal vein begins behind the pancreas and ascends to the portal fissure in the liver behind the hepatic artery and in front of the foramen of Winslow. It divides into two large branches which enter the liver. The main vein is two and a half inches long. It is behind the pancreas, but it is later accompanied by a process of pancreatic tissue. It is surrounded and

accompanied by numerous sympathetic nerves and lymphatics. The arrangement of the system facilitates a slow and even flow of blood from the digestive organs.

Tributaries :—

1. *Splenic vein* (S.V) formed by several veins from the hilus of the spleen. It passes through the lieno-renal ligament and unites behind the pancreas with the inferior mesenteric vein. It receives (a) *vasa brevia* (V.B) from the body of the stomach; (b) *left gastro-epiploic vein* (L.G.E.V) which runs along the greater curvature of the stomach, receiving veins from it, and connects the splenic and duodenal veins; (c) *pancreatic veins*.

2. *Inferior mesenteric vein* (I.M.V), which communicates with the superior mesenteric vein by a vessel which runs through the transverse meso-colon and supplies the transverse colon (T.M.C.V). It drains the large bowel from the splenic flexure to the beginning of the rectum, and it unites with the splenic vein.

3. *Superior mesenteric vein* (S.M.V), which drains the ileum and jejunum, and the large intestine from the appendix to the hepatic flexure, communicates with the venous arch in the transverse colon. At the point where it participates in the formation of the portal vein it receives the venous arch of the transverse colon, *duodenal veins* (*d.v*) and *gastric veins* (*g.v*).

4. The *cystic vein* (*c.v*) enters the portal trunk itself.

The Inferior Caval System.

The vena cava inferior is formed by the union of the two common iliac veins deep to the right common iliac artery. It ascends on the right side of the abdominal aorta. In the upper part of the abdomen it bends to the right and passes through a tunnel in the liver. Its relations are much as in the human body, but the right ovarian artery passes behind it. It receives :—

1. Four single *lumbar veins*, the first or lowest entering the left side of the vein, and the others pass into its dorsal surface.
2. *Right ovarian vein.*
3. Two *renal veins.*
4. *Right suprarenal vein.*
5. *Gastric vein* which serves as a link between the systemic and portal circulations.
6. *Hepatic veins.*

Veins of the Pelvic Extremity.

Superficial Veins :—The venous arch on the dorsum of the foot receives veins from both sides of the digits. The inner extremity is continued upwards by two internal saphena veins, which are united by cross branches. They pass upwards, dip under the sartorius and end in the femoral vein. The large external saphena vein runs up the back of the leg, dips through the fat

in the popliteal space and enters the femoral vein. There is no upward vein running through a saphenous opening, and that opening is a human characteristic.

Two venæ comites accompany all the branches of the posterior tibial artery. They unite to form one popliteal vein which accompanies the artery and becomes the femoral vein. The venous circulation closely follows the arterial supply, but no epigastric vein enters the femoral. The saphenous veins open, as described above, into the popliteal and femoral veins.

The *veins of the pelvis* follow the branches of the hypogastric artery, and the *hypogastric vein* joins with the external iliac vein to join the common iliac vein. The two common iliac veins unite to form the vena cava inferior. These veins have relations similar to those in Man.

Veins of the Pectoral Extremity.

The venous circulation differs in several points from that in Man. The veins of the hand unite to form the cephalic vein which only extends up as far as the antecubital fossa. There it dips inwards and unites with venæ comites following the branches of the brachial artery to form the brachial vein. No basilic vein is present. The brachial vein runs upwards, receiving tributaries corresponding to the branches of the artery. It is successively followed by the axillary and subclavian veins which receive tributaries corresponding to the branches of the arteries. The subclavian veins unite with the external jugular veins to form the innominate veins. The venous circulation differs from that of Man in the shortness of the cephalic vein, the absence of the basilic vein, the presence of a brachial vein instead of venæ comites, and the absence of an internal jugular vein uniting with the innominate vein.

The Ductless Glands.

The *thyroid gland* (text-fig. 41) is long, narrow, and thin. The lateral lobes are bent on themselves at the upper ends, which lie against the cricoid and lower end of the thyroid cartilage. The thicker isthmus crosses the fourth and fifth tracheal rings. There is no strong capsule and no pyramidal lobe. It receives a complicated series of arterial anastomoses from the superior (S.T.A), middle (M.T.A), and inferior (I.T.A) branches of the external and common carotids, and the thyroidea ima (T.I.A) from the left common carotid. No subclavian branches pass to the gland. The superior thyroid vein (S.T.V) opens into the anterior facial vein, and the inferior thyroid vein (I.T.V) goes to the innominate vein.

At the lower border of the isthmus there is, on each side, an oval body, the size of a pea, consisting of the *parathyroid gland* and a piece of thymus. No other parathyroid tissue was present.

The thymic constituent consisted mainly of concentric corpuscles and little lymphoid tissue. These conditions are, however, individual peculiarities.

The *thymus* (text-fig. 42), lying in the thorax, consisted of a large left part reaching the level of the third costal cartilage, and a small right part reaching the second cartilage. These parts touched over the pericardium and the left part sent a process up under the great veins. Both parts have coarse lobules, and no cavity is present in either. It is supplied by the internal mammary artery, and the veins enter the left innominate vein.

The *spleen* is small, measuring 3·8 ins. long, 2·4 ins. wide and 1·2 ins. thick. It has the same shape as in Man. The hilum is elongated. A small, oval accessory spleen is present. The artery is smaller than the hepatic artery. Other examples have larger spleens; but the form and size depend on the stages in digestion.

The *suprarenal capsules* are elongated bodies, with rounded ends, lying in the usual positions. They receive their arteries from the phrenic and renal arteries, but none from the abdominal aorta. The suprarenal plexuses are well marked.

The Blood.

Gulliver (**23**) pointed out that the red blood corpuscles have a diameter of 1/3412 inch, whereas those of Man are 1/3200 inch wide. The precipitin reactions have been described by Nuttall (**38**) who found that the blood of the Chimpanzee gives strong, positive reactions with those of *Homo* and *Simia*, but he does not mention its reaction with those of *Gorilla* and *Hylobates*.

The Lymphatic System.

The *thoracic duct* arises from a receptaculum chyli of considerable size by two vessels, which unite later. One vessel runs upwards on the right side of the thoracic aorta, and the other courses on the posterior surface of the œsophagus. At the level of the sixth dorsal vertebra the two vessels unite to form a trunk, which runs up between the œsophagus and vertebral column, and to the left side of the former. It then passes into the neck where it opens into the junction of the left subclavian and jugular veins.

No *right lymphatic duct* was detected.

The lymphatic glands are fewer than in Man, and the following groups were isolated:—

A. *Glands in the Head and Neck*:—1. A row of small glands lying on the surface of each submaxillary gland; 2. A group of both large and small glands between the cleido-mastoid and the larynx; 3. No glands were found on the surface of the parotid or along the great vessels; 4. A group of glands over the sub-occipital region.

B. *Glands in the Pectoral Extremity*:—1. Two small glands on the axillary surface of the teres major receiving vessels along the axillary vessels; 2. A row of glands, both large and small, along the course of the long thoracic artery. It is divisible into an upper group draining the glands on the teres major, and a lower group draining the side and back of the thoracic parietes; 3. No delto-pectoral nor cubital glands were found.

C. *Thoracic Glands*:—1. Several glands in the pulmonary roots; 2. Three small glands among the cardiac plexuses; 3. No retro-sternal nor vertebral glands were found.

D. *Abdominal Glands*:—1. Several small glands along the lesser gastric curvature; 2. Several small and large glands on the greater gastric curvature; 3. Numerous glands between the layers of the mesentery; 4. A chain of glands along the common iliac vessels.

E. *Glands in the Pelvic Extremity*:—1. A group of glands close to the mid point of Poupart's ligament.

It is, therefore, evident that the groups of lymphatic glands are fewer than in Man.

Respiratory Organs.

The *external nose* is small, flat, and has no lateral cartilages. It is surrounded by a groove in the upper lip. Its muscles and nerves have already been described (see p. 328). The *vestibule* is well marked, and has numerous vibrissæ. The mucosa lining the nose has the orifices of numerous glands, and the upper fourths of the septum and lateral wall have striations produced by the olfactory nerves. The *septum* is as in Man, but I could not detect any pit corresponding to Jacobson's organ. The *inferior turbinate bone* (Pl. II. A, I.T.B) is long and almost horizontal; it is prolonged backwards by a fold of mucous membrane. The inferior meatus receives the naso-lachrymal duct (N.L.D) in its middle part. The *middle turbinate bone* (M.T.B) is bifid posteriorly, and is shorter than the lower one. On elevating it, a movable mucosa-covered bony crest is revealed, and between them lies the opening of the frontal sinus (F.S) in the middle meatus. But there is no actual bulla similar to that in Man. Above the middle turbinate bone there are *three turbinal crests* with four grooves. The longest is the *superior turbinate bone* (S.T.B). The *sphenoidal sinus* (S.S) is large and opens into the upper turbinal region. It is undivided and excavates the alisphenoids. The *frontal* sinus is narrow. The *antrum of Highmore* (Pl. II. B) is large, strengthened by buttresses, and has elevations produced by the roots of the canine, premolar and molar teeth. The turbinal region has been mentioned by Zuckerkandl (**55**), Keith (**64**), and Paulli (**63**). It has several air cells in its walls.

Larynx * :—The *thyroid cartilage* is shaped somewhat differently from that in Man, for it has median notches both above and below. The angle between its alæ is about 90°. Its superior and inferior cornua articulate, as in Man, with the hyoid bone and cricoid cartilage. The *cricoid cartilage* is as in Man. The *arytenoid cartilage* is shaped as in Man, and the cartilages of Santorini and Wrisberg are very small. The *epiglottis* has the same shape as in Man. It is small and does not rise freely above the level of the aryteno-epiglottidean folds. The *true vocal cords* are attached to the thyroid alæ and vocal processes of the arytenoid cartilages. They are soft and flaccid, consisting almost entirely of mucous membrane, and a little elastic tissue. The *false cords* are likewise soft, and between them there are well-marked *ventricles*. The latter extend upwards behind the false cords to the aryteno-epiglottidean folds, and they are prolonged upwards by well-marked diverticula to the air-sac, which begins above at the excavated hyoid bone and extends downwards even into the axillæ. The cervical part of the pouch has already been described. This pouch is much larger than that described in many other animals, and resembles that in *Simia* in its extent. The communications between the sac and ventricles pierce the *thyro-hyoid* membrane, which is large. The *crico-thyroid membrane* is as in Man. The laryngeal joints (crico-thyroid, thyro-hyoid, crico-arytenoid) are as in Man.

Laryngeal Muscles :—The *thyro-hyoid muscle* runs from the lower half of the thyroid ala to the lower border of the hyoid bone. The *crico-thyroid muscle* runs from the anterior two-thirds of the lower border and outer surface of the cricoid cartilage to the lower border of the thyroid cartilage anterior to the inferior cornu. It is not fan-shaped as in Man. The *posterior crico-arytenoid muscle* arises from the posterior cricoid lamina, and is inserted into the processus muscularis of the arytenoid. It is more vertical and not so fan-shaped as in Man, and a small branch of the superior thyroid artery runs on its posterior surface. The *lateral crico-arytenoid muscle* runs from the upper border of the lateral part of the anterior cricoid arch to the processus muscularis. The *thyro-arytenoid muscle* does not divide as in Man. It runs from the inner surface of the thyroid ala in its lower half, near the mid plane, to the outer border of the arytenoid cartilage above the crico-arytenoid. The *oblique and transverse arytenoid muscles* are as in Man, but are diminutive, as is the ary-epiglottidean muscle.

Interior of the Larynx :—The ary-epiglottic folds are almost absent. Posteriorly the cuneiform tubercles and tubercles of Santorini are close together. The pyriform sinus is more marked than in Man. The upper division of the larynx is shallow, and the cushion of the epiglottis is well marked. The middle division is relatively larger than in Man. The false cords are 4 mm. apart. The lower part of the cavity is as in Man.

* Excellent illustrations have been published by Gratiolet (**22**).

The *trachea* has nineteen rings, all of which have cartilaginous hoops, with the gaps behind. The first is very wide.

Lungs:—The left lung has upper and lower lobes, and the right one has upper, middle, and lower lobes. No azygos lobe is present. The right lung receives a large bronchial artery from the descending thoracic aorta, but the left one receives a large artery from the concavity of the aortic arch, and a fine thread-like vessel from the descending aorta. Mayer (**34**) observed three lobes in the left lung, and two in the right. But Tyson (**50**), Vrolik (**51**), Gratiolet (**22**), Chapman (**12**), Hartmann (**65**), Sperino (**47**), and Symington (**48**) observed conditions similar to those in my specimen. Bischoff (**60**) observed two lobes in the left lung, and four in the right in an old animal. The bronchial glands are of moderate size, and adherent to the bronchi.

The limits of the *pleura* were described by Ruge (**43**). They presented nothing remarkable in my specimen.

Urogenital Organs (text-fig. 44).

Kidneys:—It is frequently stated that the Primates, with the exception of Man and *Ateles*, have only one renal papilla. But in this specimen, and in former animals examined by me there were respectively four and five. Ehlers (**59**), and Bischoff (**60**) noted one papilla, Symington (**48**) found the pyramids fused to form one papilla, and Sperino (**47**) noted three papillæ. The right kidney reaches lower down than the left one, and the measurements are:—

Left kidney:—	5·5 cm. long;	3·3 cm. wide;	1·6 cm. thick.
Right ,,	6·6 ,, ,,	3·3 ,, ,,	1·8 ,, ,,

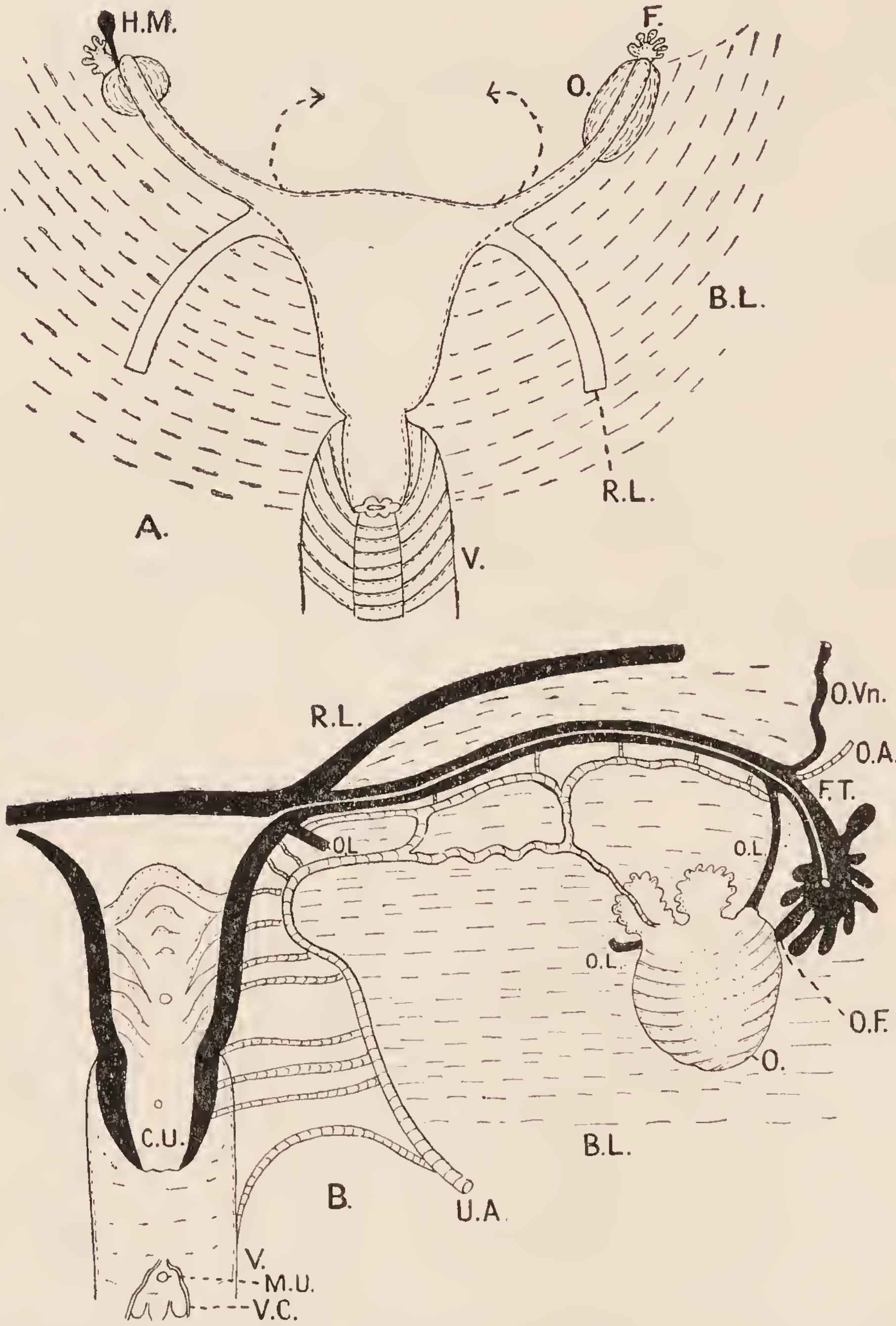
There is much peri-renal fat, but no fascial shelf supports the kidney; and there is no fat in the pelves, although Sperino (**47**) observed some. The capsule, which strips easily, is well vascularised. The cortex is thick, and sends prolongations in between the pyramids, which are finely striated. The blunt apices of the pyramids do not project much, and they are not embraced by large calyces. The relative positions of the structures in the hilum are as in Man, and the suprarenal capsules are similarly placed. The shape of the kidneys alters with the movements of the viscera apposed to them.

The *ureters* have the same course, relations, and terminations as in Man, but I was unable to detect lymphatics running along them between the kidneys and bladder.

The *bladder* is thick and muscular, but no urachus nor anterior ligaments are present. Lateral ligaments are well marked; and the thick round ligaments of the uterus are connected to them by peritoneal folds, so the utero-vesical pouch is crescentic. The mucosa is thick and corrugated, and the ureteric papillæ lie at the ends of prominent ridges. The patulous urethral orifice is close to the ridge, so the trigone is small. The vesical musculature consists of two layers. There is an external

longitudinal layer, half an inch wide, in the middle line. Lateral to this band the fibres run obliquely, both upwards and downwards, and interlace with one another. The submucous coat is thick, and composed of more elastic areolar tissue than in Man. The mucous membrane is loosely attached to it. The serous coat exhibits nothing peculiar.

Text-figure 44.



The internal organs of generation. A: anterior aspect; B: posterior aspect. B.L: broad ligament; C.U: cervix uteri; F: fimbriæ; F.T: Fallopian tube; M.U: meatus urinarius; O.A., O.L., O.F., O.Vn: ovarian artery, ligament, fimbria, and vein; R.L: round ligament; V.C: vaginal columns. Other letters in text. The arrows in figure A show the natural inward curvature of the Fallopian tubes.

Ovaries (text-fig. 44, O):—The left ovary is long, narrow and very thin, measuring $2{\cdot}5 \times {\cdot}5 \times {\cdot}2$ cm. The right ovary is flat and rounded, measuring $1{\cdot}5 \times 1{\cdot}5 \times {\cdot}2$ cm. Neither has any superficial scars nor rugæ. Each lies vertically behind the broad

ligament at a higher level than the uterus. The histology has been described by Giacomini (**66**), Duval (**67**), and Sperino (**47**). Ligaments connect it to the utero-tubal junction, and to the tube below and behind the fimbriæ. The ovarian fimbria is well marked. Sperino describes triangular ovaria. The primordial ova are innumerable, and are similar to those in the human species. And Graafian follicles can be seen in various stages of development according to Sperino.

Fallopian Tubes:—Both are 6·5 cm. long when drawn straight. They hardly increase in calibre from their uterine to their ovarian ends. The fimbriæ form a dense cluster, the ovarian fimbria is well marked, and uterine and abdominal orifices are plain; but one cannot easily pass a bristle through the tube. Each tube curves over the anterior border and upper pole of the corresponding ovary. The hydatid (text-fig. 44, H.M) is well marked on the right side. The epoophoron and paroophoron are present.

Uterus (text-fig. 44):—The uterus is isolated from the bladder and rectum by peritoneal fossæ, and its summit lies 1·5 cm. above the floor of each. There is no marked fundus, the body is triangular and the cervix is fusiform. The body is 1·5 cm. long, and its base is 1·5 cm. across. The cervix is 1·2 cm. long, and 1·1 cm. across at its widest part. It has very infantile proportions. The round ligaments are large and run directly upwards and forwards from the utero-tubal junction. The interior of the body of the uterus is smooth between the tubes, but lower down it has an upward continuation of the median dorsal crest and transverse ridges which occupy the cervix. The musculature in the upper part of the uterus is thinner than in the lower part of the body and the cervix. The external os uteri is oval, with nodulated continuous lips. Both lips are of equal length. This account differs in several respects from the accounts of Sperino (**47**), and others. Gratiolet (**22**) described a bicornuate uterus.

The *vagina* is 5 cm. long, and expands from above downwards. Anterior and posterior fornices are both present, but the latter is much the larger. In its upper part there is a median dorsal cushion, and the mucosa has transverse folds. Below that it has longitudinal folds. In its lower part it has fine longitudinal striæ and several pockets (text-fig. 44). The urethra opens on its anterior wall about the middle.

The uterine artery (U.A) supplies the vagina, uterus, tubes, ovaries, epoophoron, etc. It anastomoses with the very small ovarian artery. Its complexity is shown in text-fig. 44.

The *external generative organs* (Plate I. B) are built on the same plan as, but differ from those of the human female. The mons veneris (M.V) is slight, and has a few hairs. The labia majora (L.M) are represented by slight elevations of skin over thickenings of the subcutaneous fat. The labia minora (L.Mi) are large and folded, and divide to surround the large clitoris (CL) the latter having two crura covered by well-developed ischio-cavernosi muscles. A small fourchette exists, but there is no

hymen. The meatus urinarius is within the vagina, so no prominent vestibule is seen as in the human condition. The glands of Bartholin lie between the vagina and rectum. Sperino (**47**), Bischoff (**60**), Chapman (**12**), Gratiolet (**22**), Hartmann (**65**), Barkow (**2**), Hoffmann (**68**), Symington (**48**), and Traill (**49**) have described the external genitalia; and many of these observers have described the internal organs.

Winwoode Reade (**57**), Garner (**21**), and Mohrike (**35**) describe a sexual season, and Bolau (**5**), Ehlers (**59**), Hermes (**69**), and Keith (**30**) describe either the periodicity or characters of menstruation. Pocock (**80**) contrasts menstruation in the Chimpanzee and Hainan Gibbon.

The Nervous System *.

The *olfactory nerve* terminates by marked branches on the upper thirds of the turbinate regions and nasal septum.

The *optic nerve* is large and surrounded by a sheath of dura mater. No arteria retinæ centralis was detected in it, but the injection material may not have traversed it.

The *oculo-motor nerve* has superior and inferior divisions. The superior division does not pierce, but runs to the inner side of, the superior rectus. It supplies the superior and internal rectus muscles and ends in the levator palpebræ superioris. The inferior division runs downwards and outwards on the outer side of the rectus inferior, gives a motor branch to the ciliary ganglion, supplies the inferior rectus and ends in the inferior oblique. The branch of the superior division to the internal rectus is very large.

The *trochlear nerve* ends by three divisions to the superior oblique muscle.

The *trigeminal nerve* has three divisions as in Man, radiating from the Gasserian ganglion. The ophthalmic division courses as in Man, and breaks up into:—1. *Lachrymal nerve*, lying between the orbital wall and upper border of the external rectus. It supplies the lachrymal gland, conjunctiva and skin of the eyelids. 2. *Frontal nerve* resembles that in Man. It breaks up into supra-orbital and supra-trochlear branches. 3. *Nasal nerve.* This is distributed as in Man, but the lateral terminal branch, which is very large, comes out of the nasal cavity direct, and not between bone and cartilage, as in Man. The *ciliary ganglion* is larger than in Man. It lies on the lateral side of the ophthalmic artery and receives filaments from both divisions of the third nerve, a twig from the naso-ciliary nerve, and sympathetic filaments from the carotid plexus. It gives off short ciliary nerves: one large one, lying on the outer side of the optic nerve, divides into upper and lower divisions on reaching the eyeball. The superior and inferior maxillary divisions of the trigeminal are similar to those in Man, but I was unable to detect as many branches radiating from Meckel's ganglion. The chorda tympani

* The brain will be described in a separate paper by Professor G. Elliot Smith, F.R.S.

joins the inferior maxillary division before the latter separates into its lingual and inferior dental nerves. The submaxillary ganglion is not separate as in Man, but is fused with the hypoglossal nerve. The otic ganglion was not recognised with certainty.

The *abducens* emerges between the two heads of the external rectus and sinks into the ocular surface of the muscle.

The *facial nerve* emerges from the stylo-mastoid foramen. Its intra-petrous course was not traced. It divides in the parotid gland into temporal, zygomatic, maxillary, buccal, mandibular, and cervical divisions. The temporal branches run upwards and are distributed as in Man. The zygomatic and maxillary divisions eventually unite and give off from their combined trunk a number of branches to the muscles of the face. The mandibular and cervical divisions are as in Man. The union of the chorda tympani and trigeminal nerves has already been described.

The *auditory nerve* was not traced.

The *glosso-pharyngeal nerve* emerges from the inner part of the jugular foramen and communicates with the other nerves at the upper part of the neck. It passes between the external and internal carotid arteries, curves round the stylo-pharyngeus muscle and disappears under the free outer edge of the hyoglossus. Finally it breaks up into branches to the tongue, pharynx, and tonsil. It supplies the stylo-pharyngeus. The tympanic and petrosal branches were not traced.

The *Vagus Nerve* (text-figs. 45 & 46) emerges from the jugular foramen wherein it is lateral to the glosso-pharyngeal nerve, posterior to the internal jugular vein and mesial to the accessory nerve, to which it is closely adherent. Immediately below the base of the skull it develops the ganglion nodosum (G.N.) on its lateral aspect. The nerve separates from the ganglion again at the level of the posterior border of the hard palate. At the root of the neck it runs on to the posterior aspect of the common carotid artery and then it enters the thorax on the left side. The right one disappears under cover of the innominate artery where the latter bifurcates into right common carotid and subclavian arteries. The left vagus (text-fig. 45 A) only communicates with the sympathetic, but the right one (text-fig. 45 B) is extensively used with the sympathetic.

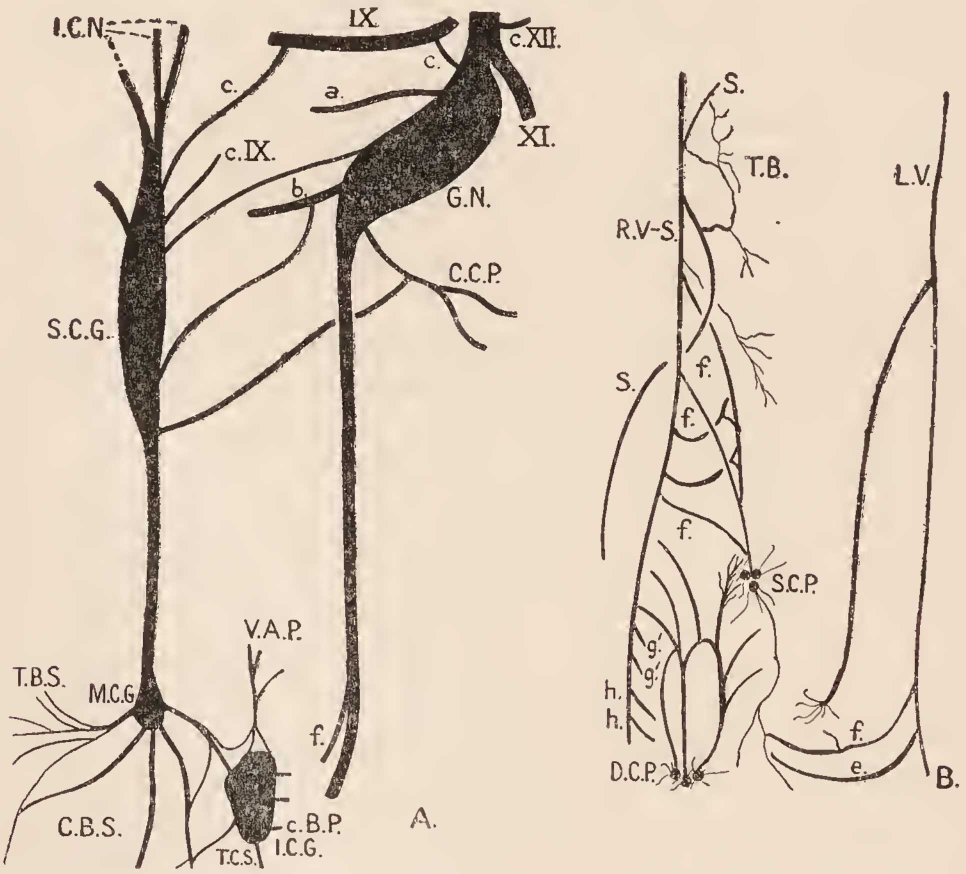
Branches in the Neck :—

1. Communicating nerves to the glosso-pharyngeal (*c.* ix), hypoglossal (*c.* xii), superior cervical ganglion of the sympathetic (S.C.G) and cervical plexus (*c.*C.P).
2. Pharyngeal nerve (*a*).
3. Superior laryngeal nerve (*b*).
4. Right recurrent laryngeal nerve (*d*).
5. Cardiac branch of the left vagus (*f*).
6. Plexus of carotid, tracheal and cardiac branches of the right vagus.

The *left thoracic vagus* (text-fig. 45 B) has the same relations and course till it reaches the posterior aspect of the pulmonary root as in Man. It gives off recurrent (*e*), cardiac (*f*), and anterior pulmonary nerves. Behind the root of the left lung it gives off posterior pulmonary nerves. It does not break up into the posterior pulmonary plexus as it does in Man. Leaving the back of the root of the lung it gains the front of the œsophagus, which position it maintains into the abdomen. It supplies the œsophagus and pleura and communicates with the right vagus.

The *right thoracic vagus* (text-fig. 45 B) gets into the thorax after crossing the right subclavian artery, at which point it gives off its recurrent branch. It crosses the right side of the trachea

Text-figure 45.



The vagus and sympathetic nerves. A: cervical parts of the left vagus and sympathetic; B: thoracic parts of the left vagus and the cervical and thoracic parts of the right vagus and sympathetic. Letters in text.

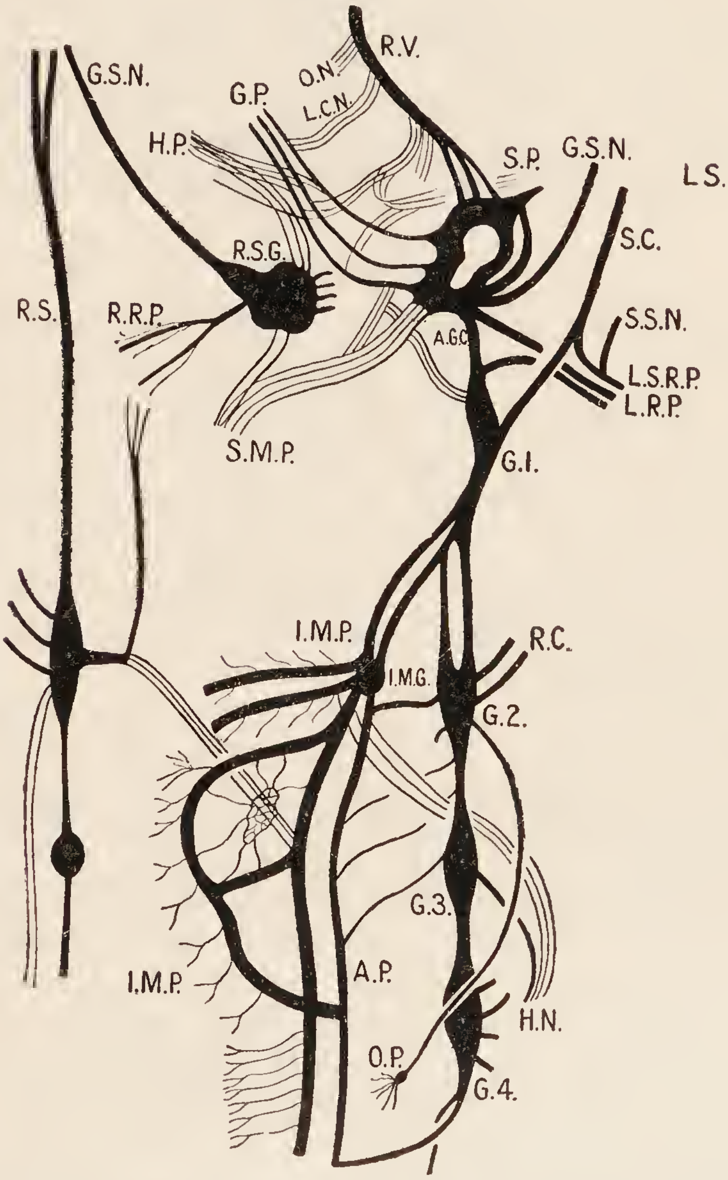
from before backwards and it is crossed by the vena azygos major. It passes down the back of the right pulmonary root and inclines downwards and backwards to reach the dorsal aspect of the œsophagus. There is no plexus gulæ. It gives off three cardiac nerves (*f*), three anterior pulmonary (*g'*), two tracheal (T.B), two posterior pulmonary (*h*), and several œsophageal nerves.

Abdominal Parts of the Vagi (text-fig. 46):—The *left vagus* passes through the anterior part of the œsophageal opening in the diaphragm, and divides into two. One branch divides into twigs which run along the lesser curvature as far as the pyloric antrum. The other branch gives twigs along the lesser curvature,

twigs running along the œsophageal branch of the cœliac axis, coronary plexus, and œsophageal nerves, which ramify over the lower end of the œsophagus. It anastomoses with branches of the right vagus. The *right vagus* (R.V) passes through the posterior part of the œsophageal opening in the diaphragm, and it ends in the left semilunar ganglion. The branches are very numerous and extend widely in the abdomen. They are:—

1. *Œsophageal nerves* (O.N) to the back of the lower end of the œsophagus.

Text-figure 46.



Abdominal parts of the vagus and sympathetic nerves. Letters in text.

2. *Gastric nerves* (L.C.N) running along the lesser curvature of the stomach.

3. Twigs to the hepatic (H.P), coronary (G.P), splenic (S), superior mesenteric (S.M.P), inferior mesenteric (I.M.P), and aortic (A.G.C) plexuses. The twigs can be traced far into the plexus, some in fact being so well marked that they can be followed to the organs. I did not trace twigs as far as the cæcum nor could I trace them to the sigmoid and rectum.

The *Spinal Accessory Nerve* emerges as in Man from the jugular foramen, pierces the cleido-mastoid, runs deep to the sterno-mastoid and gains the deep surface of the trapezius, where it has already been described. It supplies the cleido-mastoid, sterno-mastoid and trapezius, and it communicates with the cervical plexus, but not with the sympathetic.

The *Hypoglossal Nerve* emerges as in Man from the skull, and has a similar disposition till it reaches the hyo-glossus muscle. At the anterior border of that muscle it forms a loop and exhibits a swelling slightly anterior to it. This swelling receives filaments from the lingual nerve, and there is no separate submaxillary ganglion. Finally it divides into twigs for the stylo-glossus and genio-glossus. Branches:—(1) On the left nerve there is a strong *descendens hypoglossi*, but it is replaced by two branches on the right side. (2) Nerve to the *thyro-hyoid muscle.* (3) Nerves to *genio-hyoid.* (4) *Communicating to the lingual nerve.* (5) Nerves to *genio-glossus.* (6) Nerves to *stylo-glossus.*

The Cervical Plexus (text-fig. 47).

The cervical plexus is formed from the first four cervical nerves, and its relations are similar to those in Man; but there are differences in the branches. The first and second nerves form a loop. Branches of the second and third nerves form cords; a mesial cord forms the nerve to the sterno-hyoid (S-H.M) and a lateral cord forms the transverse cervical (T.C.N) and occipital nerves (O.N). Branches of the third and fourth nerves form the descending supraclavicular nerves (S-C.N). The fourth nerve communicates with the fifth.

Branches:—

I. *Superficial Cutaneous Nerves*:—Small occipital (O.N) and transverse cervical (T.C.N) from C 2 and C 3; Descending branches (acromial, sternal, and clavicular) from C 3 and C 4.

II. *Deep Muscular Branches* to sterno-mastoid (S-M. from C 2), trapezius (Tra. from C 3 and C 4), levator anguli scapulæ (L.A.S. from C 3), scalenus medius (Scal. Med. from C 4), omo-hyoid (O-H.M. from C 2), sterno-thyroid (S-T.M. from C 2), sterno-hyoid (S-H.M. from C 2 and C 3), and diaphragm (by phrenic (P.N) from C 2, C 3, C 4, C 5).

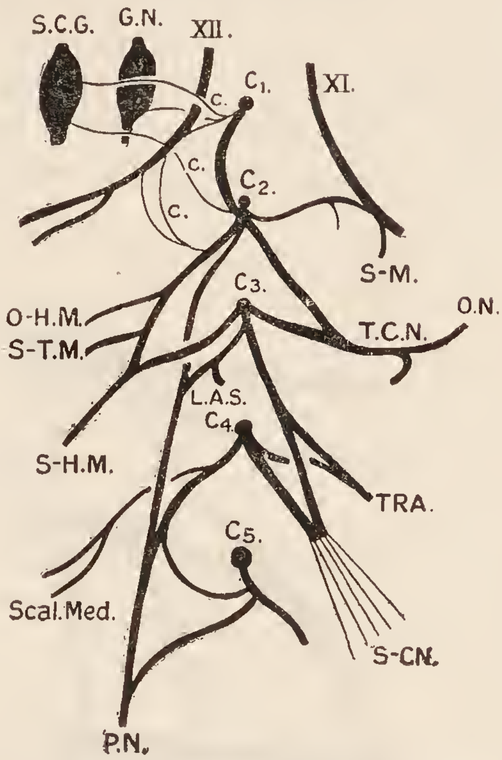
III. *Deep Communicating Branches* to vagus (G.N), accessory (xi) and hypoglossal (xii) from C 1 or C 2. There are no separate branches to the sympathetic on the left side, but the ganglion nodosum and superior cervical sympathetic ganglion are connected close to the spot where the vagus communicates with the cervical plexus. On the right side communications go from the sympathetic ganglion to the first and second cervical nerves.

There is no marked ansa hypoglossi.

The *Phrenic Nerve* (P.N) is mainly derived from the fourth cervical nerve, but it receives fine fibres from C 3, C 2, and C 5.

It passes downwards through the neck on the scalenus anticus and it enters the thorax between the subclavian artery and vein. Its general relations to the aortic arch, vagus, heart, and root of the lung are the same as in Man. Close to the diaphragm it divides into five branches which subdivide. Some of these supply the thoracic surface of the muscle, but others pass through it to

Text-figure 47.



The cervical plexus. C 1–C 5 : cervical nerves. Other letters in text.

supply the abdominal surface. It is accompanied by an artery and a vein. It gives branches to the pleura and pericardium, and communicates with the phrenic sympathetic plexus, but I did not trace branches of this anastomosis to the inferior vena cava, hepatic, and suprarenal plexuses. No arteria comes nervi phrenici was seen.

The Brachial Plexus (text-fig. 48).

The plexus is formed by the lower four cervical and first dorsal nerves as in Man, but the arrangements differ. Before they form the plexus C 5, C 6, and C 7 give off the three roots of the *long thoracic nerve* (L.T.N), and a well-marked branch runs from the upper root to the first digitation of the serratus magnus (Serr. Mag). C 7 and C 8 also give twigs to the scalenus anticus (*Scal. Ant.*).

C 5 unites with the anterior division of C 6 after giving off:—
1. A nerve to the levator anguli scapulæ (L.A.S), the rhomboidei (R.M) and the first digitation of serratus magnus (S.A.M); 2. the *suprascapular nerve* (S-S.N). As C 5 joins a division of C 6 there is no upper trunk as in Man.

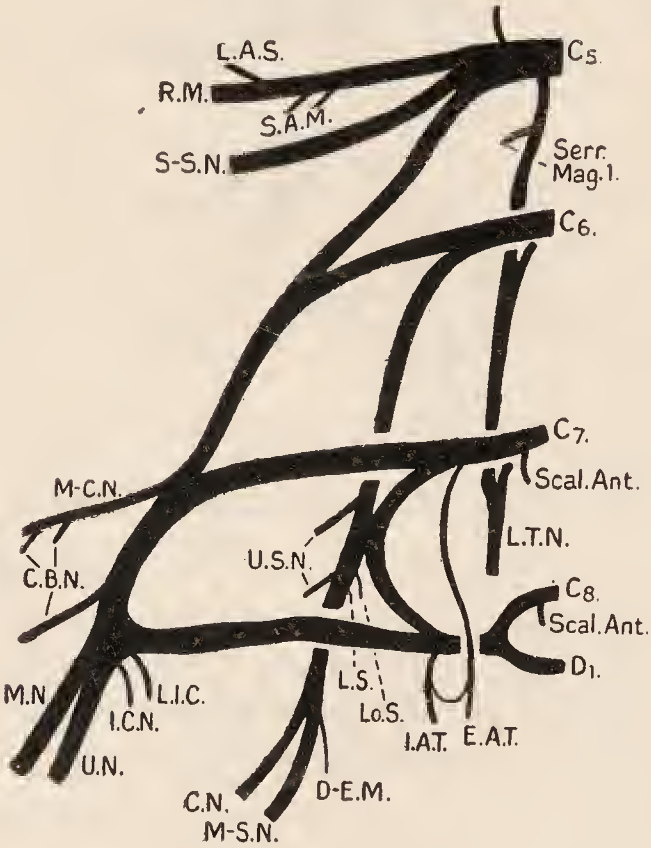
C 6 divides into anterior and posterior divisions.

C 7 gives off the *external anterior thoracic nerve* (E.A.T) and forms a trunk which divides into anterior and posterior divisions as in Man.

C 8 and D 1 unite to form a short trunk which divides into anterior and posterior divisions. At the point of division the *internal anterior thoracic nerve* (I.A.T) is given off. The two anterior thoracic nerves are connected by a loop as in Man.

C 5 and the anterior divisions of C 6 and C 7 unite to form a thick cord which, after giving off the *musculo-cutaneous nerve* (M-C.N), unites with the anterior division of the combined C 8 and D1 to form a cord, which divides into *median* (M.N) and *ulnar* (U.N) nerves. There is no separation into outer and inner cords as in Man, but the musculo-cutaneous nerve represents the former.

Text-figure 48.



The brachial plexus. C 5–D 1 : lower cervical and first dorsal nerves. Letters in text.

The posterior divisions of C 6, C 7, and the combined C 8 and D 1 unite to form a posterior cord, which gives off four *subscapular nerves* (U.S.N., L.S., Lo.S) and divides into the *musculo-spiral* (M-S.N) and *circumflex* (C.N) nerves.

The *internal cutaneous* (I.C.N), *lesser internal cutaneous* (L.I.C), and a *coraco-brachial* (C-B.N) twigs come from the representatives of the outer and inner cords.

The *suprascapular nerve* from C 5, passes through the suprascapular notch, supplies supra-spinatus and turns through the great scapular notch to supply infra-spinatus. As it passes through the greater notch it gives a second branch to the supraspinatus.

The *musculo-cutaneous nerve* from C 5, C 6, C 7, gives a branch to the coraco-brachialis and then pierces the muscle. It then gives a large branch to the biceps. Finally it divides into a muscular trunk to the brachialis anticus, and a cutaneous trunk, which gives a small nerve to the spinator longus.

Four *subscapular nerves* are present. The two upper ones go to the upper and lower parts of subscapularis. The long subscapular communicates with the musculo-spiral nerve and supplies the latissimus dorsi. The lowest nerve supplies the subscapularis and teres major.

The *median nerve* arises from the anterior divisions of all the nerves forming the plexus. It almost immediately after its formation gives a small branch to the coraco-brachialis. No branches arise in the arm. Just below the bend of the elbow it supplies the flexor carpi radialis, flexor sublimis, and both heads of the pronator radii teres. Then it communicates with the ulnar nerve by a thick branch. In the middle of the forearm it supplies the radial fibres of the flexor sublimis digitorum. About an inch distal to the radio-carpal joint it bifurcates. The outer division supplies the thenar muscles, first lumbrical, and the skin of the radial side of the index and ulnar side of the thumb. The inner division gives a small twig to the third and fourth lumbricals. Then it divides to supply adjacent sides of the second and third and fourth digits. The nerve to the second and third digits also supplies the second lumbrical. All the branches pass deep to the superficial palmar arch.

The *circumflex nerve* gives the nerve to the teres minor before it passes through the quadrilateral space. No definite anterior and posterior divisions are present. After giving off the large lateral cutaneous nerve of the arm it breaks up into deltoid branches.

The *ulnar nerve* arises in common with the median. Its course is much as in Man. In the forearm it supplies the flexor carpi ulnaris and flexor profundus digitorum and communicates with the median nerve. Two inches proximal to the wrist it divides into anterior and posterior divisions. The former supplies the hypothenar muscles, the skin of the adjacent sides of the annularis and minimus and the inner side of the minimus; and the latter goes deeply to supply the palmar interossei. A dorsal branch leaves the main trunk at the level of the pisiform bone and supplies interossei.

The *musculospiral nerve* from the posterior divisions of C 6, C 7, C 8, gives off a slender, but long, nerve to the dorso-epitrochlearis. Its course is as in Man. In the arm it gives off branches to the triceps and skin as in Man. In the lower part of the arm it supplies the supinator longus and extensor carpi radialis longior. At the bend of the elbow it divides into radial and posterior interosseous nerves. The former runs down to the skin of the wrist. The latter perforates the supinator brevis. It supplies the extensores carpi radialis longior and brevior, and the muscles

on the extensor aspect of the forearm. Finally it sends a long, fine nerve to the wrist joint.

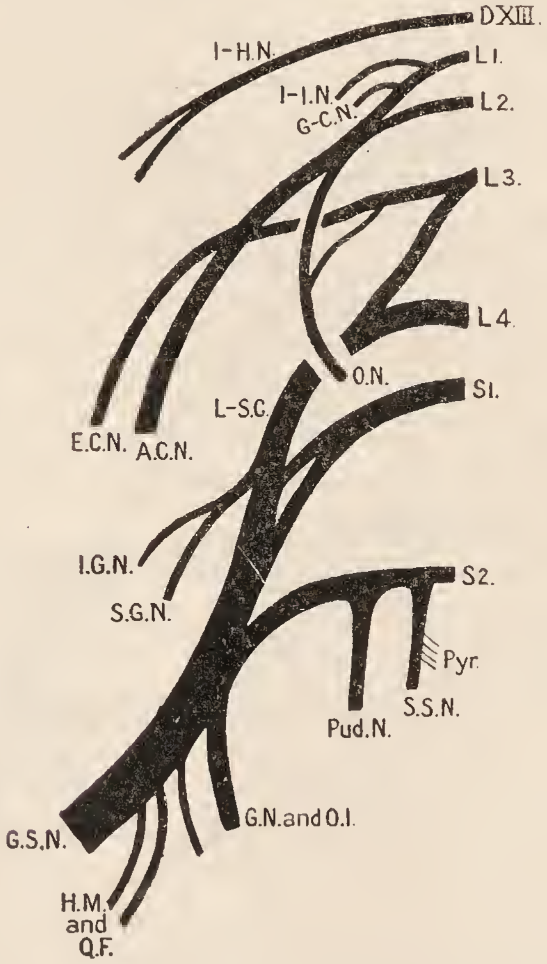
The *internal cutaneous* and *lesser internal cutaneous* nerves arise from the conjoined median and ulnar nerves in the brachial plexus. They are distributed as in Man.

The intercosto-humeral nerve is as in Man.

The Lumbar and Sacral Plexuses (text-fig. 49).

The lumbar plexus is formed by the anterior primary divisions of the four lumbar nerves, the sacral plexus is formed by the

Text-figure 49.



The lumbo-sacral plexus. D XIII–S 2: nerves forming the plexus proper; S 3 and S 4, not shown in the diagram, supply pelvic muscles; Pyr: nerves to pyriformis; H.M. and Q.F: nerves to the hamstring muscles and quadratus femoris. Other letters in text.

anterior primary divisions of the four sacral nerves. The two plexuses are connected by the lumbo-sacral cord from the third and fourth lumbar nerves. Hepburn (**24**) gives the cord as coming from the fourth lumbar, Champneys (**11**) records a totally different formation of the plexuses, but does not mention the cord. Bolk (**7**) showed that there are slight variations in different animals.

The following table shows the origins of the nerves as observed by myself and others :—

Nerve.	Bolk.	Hepburn.	Champneys.	Self.
Ilio-hypogastric ...	D xiii. D xiii.	Not recorded.	D xiii.	D xiii.
Ilio-inguinal.........	D xiii. D xiii. L 1	L 1	D xiii.	L 1
Genito-crural	......	L 1	D xiii.	L 1
Anterior crural......	L 1, 2, 3	L 1, L 2, L 3	D xiii., L 1, L 2, L 3	L 1, L 2, L 3
Lateral cutaneous...	L 1, 2	L 2, L 3	D xiii., L 1	L 2, L 3
Obturator	L 2, 3; L 1, 2, 3	L 2, L 3, L 4	D xiii., L 1, L 2	L 1, L 2, L 3
Superior gluteal ...	L iv., S 1	L-S.C, S 1	L iii., L iv., S 1	L-S.C, S 1
Inferior gluteal ...	L iv., S 1, S 2	Small sciatic.	Not recorded.	Sup. gluteal.
Great sciatic	L-S.C, S 1, S 2	......	......	L-S.C, S 1, S 2
Small sciatic.........	......	Not recorded.	L iii., L iv., S 1	S 2
Pudendal	S 2	Not recorded.	Not recorded.	S 2
N. Obturator Int....	Tibial nerve.	S 1, S 2	Not recorded.	S 2
N. Pyriformis	Peroneal nerve.	S 2	S 2	S 2
N. Quadratus Fem.	Tibial nerve.	S 1, S 2	Not recorded.	Great sciatic.
N. to Gemelli	......	S 1, S 2	Not recorded.	S 2

It is evident that D xiii. and L 1 correspond to L 1 and L 2 of Man. It is also evident that the branches of the plexus are liable to considerable variation in different animals, and I found some differences on both sides in my own. For example, the obturator nerve came from L 2 and L 3 on the right side, but from L 1, L 2, L 3 on the left.

The *ilio-hypogastric nerve* (I-H.N) is the continuation of D xiii., and it is distributed as in Man. The *ilio-inguinal* (I-I.N) and *genito-crural* (G-C.N) nerves are also as in Man; the former is large.

The *anterior crural nerve* (A.C.N) divides into anterior and posterior divisions in the upper part of Scarpa's triangle. The former gives off a cutaneous patellar branch, the cutaneous saphenous nerve and muscular branches to the sartorius, gracilis, and pectineus. The posterior division supplies the quadriceps extensor and the hamstring muscles *.

The *obturator nerve* (O.N) divides into inner and outer parts between the inner and outer heads of the adductor brevis. The former emerges to the outer side of the superficial head of the muscle and supplies the pectineus, gracilis, adductor longus, and adductor brevis. The latter emerges to the inner side of the superficial head and supplies the adductor magnus, adductor brevis, and obturator externus. No branch accompanies the popliteal artery.

The *lateral cutaneous nerve* (E.C.N) branches off from the anterior crural nerve, and is distributed as in Man.

The *great sciatic nerve* (G.S.N) at first supplies the obturator

* This distribution to the hamstrings was not observed in another Chimpanzee.

internus, gemelli, quadratus femoris, biceps, and gluteus maximus. As it courses round the tuber ischii and down the thigh it gives branches to the hamstrings. In the popliteal space it divides into external and internal popliteal nerves. The *external popliteal nerve* passes under the biceps and through the extensor longus digitorum and supplies both. It is continued as the *anterior tibial nerve.* The latter supplies the anterior tibial muscles at the top, the ankle joint, the flexor brevis digitorum, the tarso-metatarsal joints and the skin of the adjacent sides of the hallux and index. It gives off the *musculo-cutaneous* nerve which, however, only supplies the skin of the adjacent sides of the index, medius, annularis, and minimus. No *nervus suralis* exists. The internal popliteal nerve becomes the *posterior tibial nerve.* This passes between the heads of the gastrocnemius and supplies them. As it passes down the leg it gives a branch to the upper part of the anterior tibial muscles and branches to the posterior tibial muscles, peronei, ankle joint, and flexor brevis digitorum. It divides into three terminal branches. A muscular branch runs to the abductor minimi digiti. The internal plantar nerve, or second terminal branch supplies the abductor hallucis, lumbricales, flexor brevis hallucis, adductor hallucis, joints of the foot, and the skin of the inner four toes. The nerve to the last digit communicates with the lateral plantar nerve. The lateral plantar nerve, or third terminal branch divides into superficial and deep parts. The former supplies the abductor and flexor and skin on the outer side of the fifth toe. The latter supplies the adductor hallucis, interossei, and tarso-metatarsal joints.

The *superior gluteal nerve* (S.G.N) emerges above the pyriformis, and divides into two branches which follow those of the artery. A special branch runs to the gluteus minimus, but the scansorius is supplied by the sciatic nerve.

The *inferior gluteal nerve* (I.G N) accompanies the corresponding artery to the gluteus maximus.

The *pudendal nerve* (Pud.N), after emerging through the sciatic notch, forms a prominent cord lying alongside the pudendal vessels. It lies in the outer wall of the ischio-rectal fossa, but no well-marked Alcock's canal exists. It gives several twigs to the rectum, external sphincter ani, levator ani, sphincter vaginæ, and ischio-cavernosus. It also supplies the skin of the perineal region. It differs from that in Man in that it does not pierce any triangular ligament, and it has no branches to the transverse perineal muscles, for the latter are absent. It does not divide into two terminal branches of large size.

The *small sciatic nerve* (S.S.N) courses much as in Man.

I agree with Bolk (7) that the Chimpanzee, like the other Anthropoids, differs from Man in the absence of a nervus suralis.

The lumbar and sacral nerves receive grey rami communicantes from the gangliated cords of the sympathetic nerves (text-fig. 46).

The Sympathetic Nervous System (text-figs. 45 & 46).

The long, oval *superior cervical ganglion* (S.C.G) extends from the level of the hard palate to the hyoid bone. It is connected by communicating branches to the ninth (IX) and twelfth cranial nerves, and to the ganglion nodosum (G.N) and its superior laryngeal (*b*) branch. On the left side it sends no twigs direct to the cervical plexus, but it is connected to the first and second cervical nerves on the right (text-fig. 45 A.) It gives off pharyngeal nerves and the external carotid plexus, but no cardiac nerve arises from it. The internal carotid branch (I.C.N) breaks up into a plexus before it enters the skull.

The left sympathetic runs separate from the vagus and ends in the *middle cervical ganglion* (M.C.G) whence the following branches radiate:—(1) A stout cord which divides into branches accompanying the thyroidea ima artery to the thyroid gland (T.B.S), tracheal nerves and cardiac nerves (C.B.S) to the deep part of the cardiac plexus and plexus round branches of the aortic arch. (2) Nerves to the cardiac and aortic plexus (C.B.S) (3) Continuation of the cord to the inferior cervical ganglion (I.C.G). This also communicates with the vertebral plexus (V.A.P), brachial plexus (c.B.P), and cardiac plexus.

The right sympathetic fuses with the right vagus, but separates from it lower down again, and a rich plexus of nerves comes from it, both above and below, and accompanies the common carotid artery to the plexus on the branches of the aortic arch. The middle ganglion does not send off many radiations as on the left side.

The *inferior cervical ganglion* (I.C.G) and first thoracic ganglia are fused. It gives off rami communicantes to the brachial plexus (c.B.P), a thick plexus which accompanies the vertebral artery (V.A.P), a nerve to the cardiac plexus, and the thoracic sympathetic cord (T.C.S).

The *Thoracic Cords* have fewer ganglia than the number of intercostal nerves. The left one gives off the great splanchnic nerve (G.S.N) at the level of the fifth and sixth thoracic nerves. At the level of the diaphragm it divides into the small splanchnic nerve (S.S.N) and abdominal sympathetic cord (S.C). In addition to these it gives off rami communicantes to the intercostal nerves and some of these are long. Aortic nerves accompany the intercostal arteries to the plexus around the aorta, and some of these reach the root of the lung, but were very delicate at that region.

Abdominal Cords (text-fig. 46):—The left cord runs down and passes under the left renal artery. It possesses four ganglia. The first (G.1) lies at the level of the superior mesenteric artery. The cord which emerges from it gives off nerves to the inferior mesenteric plexus (I.M.P) and divides into two. The halves are collected again into the second ganglion (G.2); this gives off rami communicantes (R.C) to the first two lumbar nerves, a

branch to the inferior mesenteric plexus, and the ovarian plexus (O.P). The cord connecting the second and third ganglia gives twigs to the aortic plexus (A.P). The third ganglion (G.3) lies at the beginning of the common iliac artery. It gives off rami communicantes to the lower two lumbar nerves, hypogastric nerves (H.N) and the external iliac nerves. The fourth ganglion (G.4), situated within the pelvis, gives off strong rami communicantes to the sacral nerves, and a nerve to the hæmorrhoidal plexus. The right cord has two abdominal and one pelvic ganglia. The first ganglion gives rami communicantes to the lumbar nerves from its lateral aspect. From its mesial aspect a stout cord comes and divides into an upper branch to the left renal plexus (L.R.P) and a lower bunch of three nerves to the inferior mesenteric plexus (I.M.P). The second ganglion is at the level of the common iliac artery.

Vagus and Sympathetic Plexuses.

A. *Pharyngeal Plexus*:—This is formed by branches of the glossopharyngeal nerve and sympathetic, and the pharyngeal branch of the vagus.

B. *Cardiac Plexus* (text-fig. 45 B):—The cardiac plexus lies chiefly between the aortic arch and heart anteriorly, and the trachea posteriorly. It receives two cardiac branches of the left vagus. One rises in the neck and divides into four branches on the front of the aortic arch; two of the branches pass under the arch to the deep part of the plexus, the third runs to the surface of the arch, and the fourth supplies the pulmonary artery. No sympathetic filaments run over the arch to the superficial part of the plexus (S.C.P). The deep part of the plexus (D.C.P) communicates with the superficial part and receives:—(1) Many filaments from the left sympathetic, a thoracic cardiac branch of the left vagus, the cervical cardiac branch of the right vagus, three thoracic cardiac branches of the right vagus and filaments from the right cervical sympathetic. The plexus contains two clusters of ganglia, one behind the beginning of the innominate artery, and the other between the aortic arch and bifurcation of the trachea. The large vessels arising from the arch have associated plexuses or sympathetic nerve cords.

C. *Anterior pulmonary plexuses* derived from the vagi. No separate sympathetic filaments are seen.

D. *Posterior pulmonary plexuses* derived from the vagi and upper thoracic ganglia of the sympathetic.

E. *Solar Plexus* (text-fig. 46):—The gangliated ring, which acts as a centre, lies in front and at the sides of the cœliac axis. It receives the greater part of the right vagus (R.V) and the great splanchnic nerve of the left side (G.S.N). It gives off a trunk at its lower end which runs into the gangliated cord of the sympathetic of the left side (A.G.C). It gives off the cœliac

plexus, which breaks up into gastric (G.P), splenic (S.P), and hepatic (H.P) plexuses. It sends off the superior mesenteric (S.M.P), left renal (L.R.P) and left suprarenal (L.S.R.P) plexuses.

F. *Inferior Mesenteric Plexus* (I.M.P):—A well-marked ganglion (I.M.G) is present. It supplies the descending colon and rectum and communicates with the left abdominal sympathetic cord.

The right cœliac ganglion (R.S.G) receives the great splanchnic nerve. It is connected to the left ganglion by several communicating nerves. Offshoots go into the cœliac, right renal and superior mesenteric plexuses.

G. The *right and left renal plexuses* (L.R.P. and R.R.P) are offshoots of the corresponding halves of the solar plexus. They receive splanchnic nerves and branches from the abdominal sympathetic cords.

H. The *ovarian plexuses* (O.P) are offshoots of the abdominal sympathetic ganglia.

The Eye and its Appendages (text-fig. 27).

The skin over the supraorbital margin has a few long hairs running in different directions, but there are no pronounced eyebrows. The upper lid is longer than the lower, and has longer cilia. The Meibomian glands form projections on the back of the lid, but a strip of darkly-coloured conjunctiva prevents them from forming ridges on the ocular surface of the lid. The capacious lacus lachrymalis is lined by black conjunctiva. No caruncula is present, but the plica semilunaris is well marked. The bulbar conjunctiva is dark in colour, but only the marginal part of the palpebral conjunctiva is pigmented. The lower lachrymal papilla is larger than the upper one, and the internal tarsal ligament is larger than the lateral tarsal raphé.

The *lachrymal gland* is small and flat, and consists of two parts as in Man. The ducts open into the superior conjunctival fornix. And the naso-lachrymal duct opens below the inferior turbinate bone into the middle of the inferior nasal meatus (Pl. II. fig. A). The gland is deeply embedded in thick fat.

The fascia is very strong, and is attached as in Man to the tarsal ligaments.

Orbital Muscles:—The *levator palpebræ superioris* arises as in Man. But it has only two insertions—into the tarsus and conjunctiva—instead of three. It is supplied by the third nerve as in Man. The frontal nerve is far internal to it. The *superior oblique* arises as in Man, and the trochlea is well developed. Its long, fan-shaped tendon is inserted into the eyeball distinctly to the outer side. It passes under the superior rectus. The fourth nerve supplies it by three branches. The *rectus superior* arises, and is inserted, as in Man. As its insertion the ocular surface plays upon the anterior border of the

superior oblique. It passes through an arch formed by the capsule of Tenon. The *rectus externus* arises by two heads and is inserted as in Man. It is broad and moderately thick. The third nerve crosses both heads instead of passing between them. The fourth nerve passes over both heads as in Man. And the sixth nerve comes out between them before sinking into their ocular surface. The naso-ciliary nerve also crosses both heads. The *rectus internus* is broad and thick, and its attachments are as in Man. Its nerve, from the superior division of the oculomotor nerve supplies it by several twigs. The *inferior oblique* arises by fleshy and tendinous fibres from the floor of the orbit a quarter of an inch external to the naso-lachrymal duct. It is not spread out as in Man, but remains as a thin belly, which is inserted farther back into the sclera close to the entrance of the optic nerve on the postero-lateral aspect of the ball (text-fig. 27). The *rectus inferior* is as in Man. It is, therefore evident that the recti are almost as in Man, but the obliques and levator palpebræ differ.

The nerves and vessels are described in other sections of this paper.

The *capsule of Tenon* is very strong.

The *ophthalmic veins* are as in Man.

On pulling the eye forwards it was seen that the fascia lying next to the eyeball was seen to be well developed, and almost free from fat. The globe itself is relatively smaller than in Man, but the ophthalmoscopic appearances are very similar in both, as pointed out by Lindsay Johnstone (**70**).

Auditory Apparatus.

It is well known that the auricle is less degenerate in the Chimpanzee than in Man and the other Anthropoids. And from the numerous accounts which have been published it appears that the auricle is one of the most variable parts of the external anatomy of the Chimpanzee. Its very complete form in my specimen is shown in Plate I. fig. A. It has few hairs, and Wallis (**58**) pointed out that it has this feature in all examples. Darwin (**16**) noted that neither the Orang nor the Chimpanzee move their auricles, and I was unable to detect any movements on any occasion when I made observations in the Ape House in the Gardens. In Plate II. fig. B it is shown how the auricular cartilage is very complete, and it has a wide, thin peripheral rim. But the human auricular cartilage is a totally different thing. I was unable to detect intrinsic muscles in the cartilage.

The tympanic membrane cannot be seen through the ordinary aural specula, for it lies at the end of a long, bony external auditory meatus.

The Eustachian tnbe has no well-marked torus round its pharyngeal end, and I did not detect a salpingo-pharyngeus muscle.

Doran (**71**) pointed out that the auditory ossicles, taken as a whole, resemble those of Man more than do those of the Gorilla and Orang. But in these Anthropoids the ossicles resemble those of Man more than do those of the Chimpanzee in a few points. In the Chimpanzee the malleus is more human than those of the Gorilla and Orang. "In the shape of its head, which projects markedly forwards, and in the nature of its articular surface, of which the outer segment is much the widest, it approaches *T. gorilla* more than *Homo* or *Simia*; but in the neck and manubrium it is very human, the only difference being that the latter, in this ape, is narrower at the base, and more curved than in Man, and its well-developed processus brevis is directed upwards, and hardly outwards. In length the handle does not exceed that of our species—another prominent distinction from the other two apes. The body of the incus resembles that in *Homo*: the processus brevis is more slender, and ends in a sharp point, with no trace of any depression on it. The processus longus is rather stouter and shorter than in Man; it forms with the posterior crus a right angle. The stapes is smaller than in Man. The crura are almost equally curved; they are shorter and more slender than in Man, but wider apart at their insertion. They are well grooved towards the aperture which is wide. The base resembles that of *Homo*, though less distinctly reniform, and equally rounded off at both extremities."

The Skin and Tegumentary Organs.

As the Chimpanzee uses the extensor surfaces of his fingers in progression the skin has become modified. On the penultimate phalanges it exhibits long, oval callosities; and it has papillary ridges on its terminal ones. These ridges appear to increase during the period of growth, and Kidd (**56**) after describing their longitudinal direction states: "their long axes are at right angles to the line of progression of the animal. There is no correlation between the act of prehension and the direction of the ridges, though it agrees closely with the general rule which obtains in so many regions, that the ridges lie at right angles to the line of incidence of the predominating pressure on the part."

The mammæ are two in number, and pectoral in position. The umbilicus was very faint in this specimen.

The following account of the comparative histology of the hairs of the Anthropoid Apes has been written by Mr. F. Martin Duncan, F.R.M.S., F.Z.S.:—

The hair of the Chimpanzee is lank, coarse in texture, and jet black in hue. Microscopically it presents certain interesting features. The cuticular scales are well marked, narrow, and of the imbricate-ovate type characteristic of the Anthropoid Apes, and in contour bear a closer resemblance to *Gorilla* than to *Simia*. In the cortex, between the cuticular scales and the medulla, the pigment granules are very numerous, opaque, and

tend to coalesce in short, regular lines. The medulla is continuous, homogeneous, and densely pigmented. The hair shaft is cylindrical. (Pl. III. fig. A.)

A transverse section of the skin, passing across a hair-follicle, shows the thick outer and inner root-sheath, with the layers of Henle, and of Huxley, both well developed; while the mass of elastic tissue closely surrounding the hair-follicles presents a very striking appearance (Pl. III. figs. B and C).

Pathology.

Nothing is known of the diseases to which the Chimpanzee is subject in its native surroundings. In captivity in Europe it usually succumbs to diseases of the respiratory or digestive organs. Some animals die from generalised tuberculosis, or from osseous and arthritic changes after many years in confinement. The following table, compiled from the death reports, shows the causes of death and duration of life of animals which have been in the Society's Gardens since 1882.

No.	*Date of Death.*	*Life in the Gardens.*	*Cause of Death.*
1.	7. 5. 1882	1 month.	Ulcers of tongue. Viscera healthy.
2.	8. 6. 1883	16 days.	Pneumonia.
3.	29. 10. 1883	5 „	Typhoid fever *.
4.	22. 6. 1884	1 month.	Bronchopneumonia. Ascites.
5.	4. 11. 1886	4½ months.	Acute bronchitis.
6.	20. 3. 1889	11 days.	Pneumonia.
7.	1. 6. 1889	1 year, 7 days.	Bronchitis.
8.	15. 4. 1891	2 years, 4 months.	Pneumonia.
9.	28. 8. 1891	7 „ 10 „	Pneumonia, peritonitis (TB.).
10.	15. 11. 1891	4½ months.	Pneumonia.
11.	23. 9. 1895	1 year, 5 months.	Hypertrophied liver. Ascites.
12.	17. 11. 1895	8 months.	Bronchitis. Pneumonia.
13.	12. 12. 1896	5 months, 9 days.	„ „
14.	13. 12. 1896	1 year, 2 months.	„ „
15.	1. 6. 1897	4 days.	Not opened.
16.	27. 9. 1898	3 „	Debility.
17.	8. 10. 1898	1 year, 5 months.	Bronchopneumonia.
18.	3. 12. 1899	11½ months.	Not examined.
19.	6. 12. 1899	7 months.	„ „
20.	24. 3. 1900	4 years, 1 month.	Chronic pneumonia.
21.	16. 10. 1901	10 months, 1 week.	Pneumonia. Hepatic congestion.
22.	9. 1. 1903	7 months.	Prolapsus ani. Killed by order.
23.	4. 12. 1904	1 year, 10 months.	Bronchitis.

* Authority J. B. Sutton.

No.	*Date of Death.*	*Life in the Gardens.*	*Cause of Death.*
24.	20. 3. 1905	1 month.	Generalised tuberculosis.
25.	16. 1. 1906	3 months, 3 days.	Colitis.
26.	24. 4. 1907	4 years, 0 months.	Trauma.
27.	7. 9. 1907	2 „ 5 „	Ulcerative colitis.
28.	19. 11. 1907	3 years, 12 days.	Colitis. Enteritis.
29.	6. 7. 1908	1 year, 2 months.	Bronchopneumonia.
30.	8. 7. 1908	3 years, 2 months.	„ „
31.	20. 12. 1917	4 „ 7 „	Fracture of skull.
32.	9. 1. 1918	7 „ 3 „	Pneumonia.
33.	1. 8. 1919	10 „ 10 „	Chronic arthritis.
34.	7. 10. 1922	2 „ 6 „	Pneumonia.

It has been shown by Metschnikoff, Roux, Neisser, and Lassar that the Chimpanzee is more susceptible to the virus of syphilis than any other Ape or Monkey. The primary lesions appear in thirty days after inoculation; the secondary symptoms develop after a further period of more than thirty days; but tertiary signs have never been observed.

All experimental inoculations with the gonococcus have failed to produce a result.

Keith has collected papers by Owen (75, 76), Schmidt (77), Rollet (78), and Meyer (79) on the pathology of the Chimpanzee. And the works of Ehrlich and Hata give accounts of the transmissibility of yaws to Apes; but the actual Apes employed have not been mentioned.

I desire to express my thanks to Dr. Doreen Stranger, Dr. J. H. James, Miss Kahan and Messrs. Aurounin, Henderson, Meneces, and McCormick, students in the Anatomy Department of University College, for their assistance in the dissection of the animal described above.

Comparisons with Man.

The Chimpanzee resembles Man in a general way in form and structure, but it differs from him in many respects. Some of the differences are associated with habits and diet; others are dependent on differences in the size and complexity of the brain; and others again are the outcome of different developmental processes.

At a certain stage the fœtuses of the Chimpanzee and Man have several features in common, but the subsequent developmental changes—both intrauterine and extrauterine—proceed in different directions. In the Chimpanzee they are marked by a progressive increase in certain parts, such as the hair and facial skeleton. In Man, on the other hand, they are characterised by suppression; but the power to develop farther lies dormant.

The suppressive agents are the various ductless glands. When they are diseased the suppressive power is removed, the latent power reasserts itself, and Man assumes certain ape-like characters. Man, in fact, retains more fœtal characters than the Chimpanzee. The most distinctive character of the human fœtus is the foot, for it has never been seen with the hallux projecting from the postero-mesial aspect of the sole.

The Chimpanzee differs from the white races of Man in its pigmented, hairy skin, its thick lips, and its overgrown facial skeleton, which exhibits large supra-orbital crests, prominent zygomata and malar bones, prognathism and large mandible. But diseases of the ductless glands cause Man to assume one or more of these characters, for they remove the suppressive agencies. In Addison's disease of the supra-renal capsules the skin becomes pigmented; and in the various disorders of the pituitary body, so beautifully monographed by Cushing (**15**), the lips thicken, the skull exhibits large crests, zygomata and malar bones, maxillary or mandibular prognathism occurs, and there is a variable amount of hirsuties. The extremities also become large and clumsy. Many of these conditious are present as the normal characteristics in the lower races of Man; and one of the most prominent features in the skull of *Homo rhodesiensis* is the enormous development of the supra-orbital crests.

At a certain stage in development the fœtuses of all Primates have external genital folds. In the human fœtus they continue to develop and form the labia majora and mons veneris, and they bury the labia minora and clitoris. In the lower Primates they disappear and the clitoris is exposed on the surface. But the Chimpanzee exhibits an intermediate condition. The mons veneris is slight, and the labia majora are represented by two slight elevations of the skin over thickenings of the subcutaneous tissue (Pl. I. fig. C). The chief difference between the Chimpanzee and Man is the absence of the hymen. In diseases of the ductless glands the organs atrophy in Man.

The biochemical reactions of the blood show that Man is related to the Chimpanzee and other Anthropoids, and it is evident from the above that the actions of the ductless glands have altered the appearances of these relatives in a pronounced manner. Bolk (7) has shown that the suppressive action has not only influenced the somatic features of Man, but it has retarded his development and succeeding life phases. He believes that the ancestor of Man changed his diet from frugivorous to omnivorous, and the change may have been the factor which evoked the suppressive action of the endocrine organs.

The compressed head appears sunk between the shoulders, for the neck is short. It is also more rigid than in Man. This arrangement throws no obstacle in the way of the long arms, and the shortness of the neck may be designed to give the powerful levator anguli scapulæ and levator claviculæ a very strong fixed origin.

If some object is held above the animal's head one can see that there is a considerable upward movement of the eyeballs, but the head does not move much. And the greater upward movement of the eyes compared with that in Man is effected by a more posterior attachment of the inferior oblique muscle.

The Chimpanzee uses its arms as hook-like suspenders, but the diminutive thumb is of no great use for suspension. The new-born child can, it is well known, support the weight of its body for a half to two minutes in a similar manner. Its fingers reflexly assume this position if one places his index finger in its palm.

Much has been written about the attitude of the Chimpanzee, but the conclusions, in several instances, have been drawn from the study of dead material, or from the observation of sluggish animals moving clumsily across the floors of their cages. Those who have observed Chimpanzees in their natural haunts testify to their activity and agility; and I have been fortunate in being able to examine a male Uganda Chimpanzee, lately arrived at the Gardens, which still exhibits much of its original activity. It runs about actively, using its arms and legs almost equally; it occasionally uses its foot as a spring-board; and it swings about on the branches in its cage very actively.

Anatomical descriptions state that the Chimpanzee keeps its knees semi-flexed and give that as one of the factors which prevent the animal from assuming the erect attitude. And Humphry (26) states that one cannot fully extend the knee without doing violence to the muscles. If, however, the living animal is examined a different state of affairs can be observed; but the observations must be long and frequent. I observed the active animal mentioned above extending its joints fully, both during active progression and while standing up and holding on to the bars of its cage. Two young animals were then examined during their active movements, and the same conditions were observed. After studying the active range of movement I examined the passive movements in two other young animals, and I found that I could easily extend the knees; but the curvature of the upper end of the tibia gave the leg an apparent slight flexion even when the knee is lightly extended. It is, therefore, evident, from the results obtained on these five living animals that the knee-joint can be fully extended. The position of semi-flexion is, however, more comfortable in the Chimpanzee, as it is in Man, and an animal which becomes sluggish in captivity will develop stiff joints, so full extension of the knee will then become impossible, either actively or passively. And I believe that some anatomical accounts have been based on the examination of limbs so affected.

If the animal were deprived of its arms it could not stand upright like Man, but it can under momentum be erect for a short period; I have observed the active animal mentioned above

run for a few paces in the erect posture. The maintenance of the erect attitude in Man is effected by a very complex and beautifully adjusted nervous, muscular, and osseous mechanism; but many factors co-operate in the Chimpanzee to make it quadrupedal when on the ground. In the first place, the centre of gravity is high, for the greatest weight of the body is nearest the arms. The animal will naturally fall to the ground unless it uses its arms as supports. In Man, on the contrary, the centre of gravity is low down near the supporting legs. As distension of the abdomen by food and pregnancy throws the line of gravity farther forwards in Man, the effect of similar conditions on the Chimpanzee will make the arms all the more necessary as supports. In the second place, the muscles of the back are more rigid in the Chimpanzee, so they are not employed as in Man for adjusting the balance to suit awkward positions. Thirdly, the arrangement of the bones and joints of the pelvis and lower limbs in the Chimpanzee is such that the lower limbs cannot be converted into strong supporting pillars. Finally, the muscles are not so subdivided as in Man, so the movements are more massive. There is not the fine co-ordination of movements which Man obtains through a highly organised brain, a delicate and complex nervous mechanism, and a subdivided muscular system, whose elements can group themselves to produce complex actions.

The Chimpanzee experiences joy and anger, and young ones manifest jealousy if their companions are petted. It expresses these emotions by grimaces instead of fine facial expressions. The lips and cheeks exhibit gross movements, and many teeth are exposed. The reasons for this are the coarseness of the platysma and its very intimate union with the labial muscles; and the latter are coarse, fused, and devoid of fine subdivisions.

The muscles of mastication are built on the same plan as in Man, but they are more powerful. And the prognathism makes the levatores and tensores palati more horizontal than in Man.

The columns of the erector spinæ are coarser than in Man, and pass farther up into the neck. And the shortness of the neck almost obliterates the sub-occipital triangle.

The muscles attached to the shoulder girdle are so arranged that the arm can be moved far backwards. In addition to the usual elevators, which are more powerful than in Man, there is a levator claviculæ. The nerve supply to the rhomboideus, levator scapulæ, and first part of the serratus magnus is very rich. The Chimpanzee has also a dorso-epitrochlearis.

If several animals are examined it is seen how the pectoralis minor writes its evolutionary history.

There is considerable fusion between the muscular bellies of the flexors and extensors of the wrist and fingers. The flexor carpi ulnaris is more bulky than in Man, and it is inserted into a

very large pisiform bone. The trapezium, on the other hand, is small, and there is no os centrale as in *Simia*. The minute flexor longus pollicis is an offshoot of the tendon of the flexor profundus to the index. The palmaris brevis is large, the first and second lumbricales are connected by a muscular slip, and there are six palmar interossei. Still those anatomical differences are not sufficient to show that the hand of the Chimpanzee is not such a marvellous mechanism as that of Man.

The muscles of the abdominal parietes are very strong, for they act as flexors of the trunk, and they support the abdominal viscera when the animal is walking. A pelvic floor is present, but there is no true central point of the perineum, which plays such an important part in supporting the uterus in woman. The vulva and anus are behind a line connecting the anterior extremities of the ischial tuberosities, but a corresponding line in woman passes between the vulva and anus.

The quadratus lumborum is shorter than in Man, and is strongly fused with the iliacus, and the latter is longer than in Man. The glutei are less than those in Man, but the maximus has a longer insertion. The glutei and other thigh muscles exhibit a considerable degree of adhesion, and some of the thigh muscles are inserted into the fascia over the muscles of the leg. The scansorius is absent in Man. The adductors form a powerful mass, and they help to keep the inverted foot against a tree in climbing; from the backward projection of the ischium the adductor magnus is a powerful extensor of the leg in leaping. In the muscles of the leg it is interesting to note the doubling of the tibialis anticus and the absence of a tibial head of the soleus.

Anatomical literature contains many speculations as to the nature of the foot of the Chimpanzee. Cuvier, Blumenbach, and Owen, and in later years Huxley (**27**), Humphry (**26**), and Embleton (**19**) have proposed different views. A survey of their writings shows that it has been regarded as a foot, a hand, or a compromise between them, that is a chiropodous structure. To settle this question it is necessary to consider the extremities from the anatomical and physiological points of view, and it is necessary to examine them in several animals. Using the human hand as a standard, it is, in the first place, necessary to see how it differs from a fore-foot. Humphry (**26**) points out that the elongation of the phalanges and the shortness and opposability of the pollex are the characters which transform a fore-foot into a hand. In the case of the terminal part of the lower extremity many of the myological and osseous features are characteristic, not of a hand or a foot, but of a hind limb. So we must look to the characters of the digits and hallux to determine the nature of the part in the Chimpanzee. Comparing the measurements in

the animal whose anatomy is described in this paper with those in Man the following results are obtained :—

	Chimpanzee.	*Man.*
End of heel to tip of middle digit ...	7·4 ins.	8·4 ins.
Hallux and its metatarsal bone	4·0 ,,	4·5 ,,
Hallux without metatarsal bone ...	2·2 ,,	2·3 ,,
Length of metatarsals 2–5	2·0 ,,	2·5 ,,
Length of phalanges :—		
second digit	2·5 ,,	1·8 ,,
third ,, ...	2·8 ,,	
fourth ,, ...	2·5 ,,	
fifth ,, ...	2·3 ,,	
Total length of second digit	4·5 ,,	4·3 ,,

It is thus seen that in the Chimpanzee the phalanges of digits 2–4 are more than a third of the length of the foot, but the fifth digit is less than a third; but in Man they are less than a quarter of the length of the foot. The hallux in the Chimpanzee is shorter than the other digits, but it is slightly longer than them in Man. In the Chimpanzee the relative lengths of the digits are as in a hand, and the digits act towards or from a line passing through the middle digit; in a foot the basal line passes through the second digit. All these data show that the pelvic extremity in the Chimpanzee is terminated by a hand. And if the grasping action of the human hand be taken as a pattern it is even more effective than the hand which terminates the pectoral extremity. The hind hand is not employed as an exploring organ, and its grasping action is chiefly an aid to progression, so Humphry (26) thinks that the term "chiropod" best describes it. And he makes the following important statement:—"Whichever term is used it must not be forgotten that the configuration on which it is based is not peculiar to the monkeys, but is common to them with some other tree-roving animals, such as Iguanas and Opossums. In human beings, who are born without arms, the foot can be educated to take the place of the missing hands. And medical literature contains records of such persons who could grasp objects and carry out complex movements, such as painting, with their hallux and foot digits. These cases have been adduced by some writers to prove that the leg of the ape is also terminated by a foot. They do not really disprove the views stated above for:—1. The proportions of the hallux and digits to each other and to the whole foot are normally foot-like; 2. The middle line, or basal line, runs through the second digit; 3. The hallux can be abducted, but it is not really opposable; 4. The prime work is to act in conjunction with the other characters of the leg in forming a strong supporting basis for the body.

The joints between the occipital bone, atlas, and axis differ from those in Man. The inferior crus of the cruciate ligament is absent, and there are additional strengthening bands. No

ligamentum nuchæ is present. Owing to the greater forward projection of the odontoid process, the check and middle odontoid ligaments are more horizontal than in Man. The articular processes cause more locking of the atlas and axis. The head has a much more limited movement, and this is accompanied by a greater upward mobility of the eyeballs. The carpal ligaments are more complex than in Man. And the construction of the joints of the pelvis and leg are such that the animal cannot stand stiffly in a fully erect attitude without holding on to branches above it.

The mouth differs from that in Man in the greater number of palatal rugæ and in the characters of the tongue, although Wood-Jones states that the tongue is like that in Man. The pharyngeal musculature is similar in both, but the Chimpanzee has the larger sinus of Morgagni. Man has only two muscular coats in his œsophagus, but the Chimpanzee has an additional inner longitudinal coat in its upper part. Man has three muscular layers in his stomach, but the Chimpanzee has only two; and the inner coat is composed of oblique or circular fibres in different parts. As regards the intestinal tract the most striking differences are found in the rectum The Chimpanzee has five enormous valvulæ conniventes running completely round it, and the columns of Morgagni are very prominent longitudinal folds running down to the lower end of the anal canal. When the anus is dilated these columns are seen at once. No valves of Bull connect the columns as in Man. The anus is prominent as the gluteal regions are small, whereas the reverse is the case in Man.

The amount of lymphoid tissue in the intestinal mucosa is less in the Chimpanzee than in Man.

The liver and pancreas are practically the same in both.

The heart is small in the Chimpanzee, but its structure is as in Man. The branches of the aortic arch take one of two forms, and one of these varieties is as in Man. The subclavian arteries give off well-marked spinal branches, and the branches of the axillary artery come off as in the Cercopithecidæ. No arterial anastomoses exist round the scapula or elbow joint as they are in Man. The vessels in the forearm form long parallel branches, much as in the Lorises, and there are three palmar arterial arches, whereas Man has only two. The branches of the abdominal aorta are fewer than in Man; and in my specimen the femoral artery gave off branches which combine those of the external iliac and femoral arteries in Man. The femoral artery gives off a saphenous artery to the foot, and the anterior tibial artery courses differently from that in Man.

In the venous system the chief differences from the condition in Man are the freer intercommunications between the parts of the portal circulation, the absence of a saphenous opening, the ending of the cephalic vein in the lower end of the brachial veins, and the presence of a large brachial vein instead of two venæ comites of the brachial artery.

The lymphatic system is characterised by a doubling of the thoracic duct; and the groups of glands are much fewer than in Man.

The ductless glands generally resemble those in Man. But the thyroid is a long, narrow U-shaped organ instead of being composed of an isthmus and two lateral lobes. The vascular supply is interesting in my specimen, but I am unwilling to regard it as the normal condition till other material becomes available for examination.

The lungs are divided into the same number of lobes as in Man, but they are subdivided differently. The trachea and bronchi are as in Man, but the larynx differs in some points of structure, and in the possession of a large air-sac. Vrolik has shown that they are largest in the aged, and it is possible that this fact is correlated with weaker muscles at that period of life.

The external generative organs have already been alluded to. The internal organs are built on the same plan; but the round ligaments are relatively much thicker than in the human condition. They may play a more important part in fixing the uterus than they do in woman. The vestibule is very small, and the meatus urinarius opens within the vagina.

It is sometimes stated that Man and *Ateles* are the only Primates which possess more than one renal papilla. But that is not the case, for I have seen kidneys of Chimpanzees with three to six papillæ. The left renal artery is peculiar in my specimen for it anastomoses with lumbar arteries, whereas the renal arteries are end-arteries in Man.

In its origin from the femoral artery, and its course up through the femoral sheath the obturator artery in my specimen courses as in one form of abnormality in Man.

Man differs from the Chimpanzee in being bimanous and bipedal, and in the possession of those higher mental powers which we designate by the name of the Soul.

Bibliography.

1. Alix, E.—Annales des Sciences Nat. ser. 5, t. viii. p. 295; t. ix. p. 5.
2. Barkow, H.—"Comp. Morph. des Mensch. v. der Menschähnliche Tiere." Breslau, 1863.
3. Beddard, F. E.—Trans. Zool. Soc. London, 1892, vol. viii. pp. 177–218.
4. Bland-Sutton, J.—Journal of Anatomy and Physiology, 1884, pp. 66–85.
5. Bolau, H.—Abh. aus dem Gebiete der Naturwiss. Hamburg-Altona, 1876.
6. Bolk, L.—Lancet, 1921, pp. 588–592.
7. ,, Morphol. Jahrb. xxv. pp. 306–361.

8. Brooks, St. J.—Journal of Anatomy and Physiology, 1888, pp. 78–95.
9. Brühl, C. B.—Wien. Med. Woch. 1871, pp. 4–8 & 52–55.
10. Chaîne, J.—C. R. Soc. Biol. lix. pp. 623–630.
11. Champneys, F.—Journal of Anatomy and Physiology, 1872, pp. 176–211.
12. Chapman, H. C.—Proc. Acad. Nat. Sci. Philadelphia, 1879, pp. 52–63.
13. Cunningham, D. J.—Cunningham Memoirs, Roy. Ir. Acad. Dublin, 1886.
14. Cunningham, D. J.—'Challenger' Reports. *Zoology*, vol. v. 1882.
15. Cushing, H.—"The Pituitary Body and its Disorders."
16. Cuvier.—"Leçons d'Anatomie comparée," vols. i. & ii.
17. Darwin, Ch.—"The Expression of the Emotions in Man and Animals." London, 1890.
18. Dwight, T.—Mem. Boston Soc. Nat. Hist. 1895, pp. 35–52.
19. Embleton, D.—Nat. Hist. Rev. 1864, pp. 250–258.
20. Flower, W. H.—Med. Times and Gazette, 1872, pp. 335, 392.
21. Garner, R. L.—"Gorillas and Chimpanzees," 1896.
22. Gratiolet, P.—Nouv. Arch. du Mus. Hist. Nat. 1866, pp. 1–263.
23. Gulliver, G.—Proc. Zool. Soc. London, 1845, pp. 93–102.
24. Hepburn, D.—Journal of Anatomy and Physiology, 1892, pp. 149–186; 324–356.
25. Hoffmann, G.—Zeitschr. f. Geburts. und Gynäk. 1878, pp. 1–8.
26. Humphry, G. M.—Journal of Anatomy and Physiology, 1867, pp. 254–268.
27. Huxley, T. H.—"Evidence as to Man's Place in Nature." London, 1863.
28. Kallius, E.—Inaug. Diss. Berlin, 1892.
29. Keith, A.—Natural Science, 1896.
30. ,, Proc. Zool. Soc. London, 1899, pp. 296–312.
31. Kollmann, A.—Arch. Anat. u. Physiol. 1885, pp. 56–101.
32. Lartschneider, J.—Denkschr. k. Ak. Wiss. Wien, 1895 pp. 95–136.
33. Macalister, A.—Ann. & Mag. Nat. Hist. 1871, pp. 341–351.
34. Mayer, C.—Arch. f. Naturgesch. 1856, pp. 281–304.
35. Mohrike, O.—"Das Ausland," 1872.
36. Moore, E. G.—Quoted by Wilder (see no. 53).
37. Nepheu, M. G.—Ann. Sci. Nat. 1869, pp. 326–337.
38. Nuttall, G.—"Blood Immunity and Blood Relationship." Cambridge, 1904.
39. Owen, R.—Proc. Zool. Soc. London, 1836, pp. 41–42.
40. Parsons, F. G.—Journ. Anat. Physiol. 1898, p. 436.
41. Rex, H.—Morph. Jahrb. 1887, pp. 275–286.
42. Ruge, G.—"Untersuch. u. die Gesichtsmuskeln der Primaten." Leipzig, 1877.

43. Ruge, G.—Morph. Jahrb. 1893, pp. 149–249; pp. 376–427; 1894, pp. 305–397.
44. Retterer, E.—C. R. Soc. Biol. lviii. p 476.
45. Smith, G. M.—Journal of Anatomy, 1910, 1911, 1912.
46. Sonntag, C. F.—Proc. Zool. Soc. London, 1921, pp. 1–29.
47. Sperino, G.—"Anatomia del Cimpanzè." Torino, 1897.
48. Symington, J.—Proc. Phys. Soc. Edin. 1890, pp. 297–312.
49. Traill, Dr.—Mem. Wern. Nat. Hist. Soc. Edin. 1817, pp. 1–49.
50. Tyson, E.—"Orang-outang, *sive* Homo sylvestris." London, 1699.
51. Vrolik, W.—"Recherches d'Anatomie Comparée sur le Chimpanse." Amsterdam, 1841.
52. Waldeyer, W.—Monit. Zool. Ital. No. 4, pp. 73–74.
53. Wilder, B.—Boston Jour. Nat. Hist. 1862, pp. 352–382.
54. Wyman, J.—Proc. Boston Soc. Nat. Hist. 1856, pp. 274–275.
55. Zuckerkandl, E.—"Das Periphere Geruchsorgane der Säugetiere." Stuttgart, 1887.
56. Kidd, W —Proc. Zool. Soc. London, 1904, p. 263.
57. Reade, W.—"Savage Africa." London, 1864.
58. Wallis, H. M.—Proc. Zool. Soc. London, 1897, pp. 298–310.
59. Ehlers, E.—Abh. Phys. Cl. Ges. Wiss. Göttingen, 1881, p. 77.
60. Bischoff, T. L. W.—Mitth. K. Zool. Mus. Dresden, 1877, pp. 251–260.
61. Cavanna, G.—Arch. per l'Antropologia, 1876, pp. 211–215.
62. Sonntag, C. F.—Proc. Zool. Soc. London, 1922, p. 441.
63. Paulli, S.—Morph. Jahrb. xxviii. (several papers).
64. Keith, A.—"Human Embryology and Morphology."
65. Hartmann, R.—Arch. f. Anat. und Physiol. 1872 (several articles).
66. Giacomini, C.—Quoted by Sperino (see no. 47).
67. Duval, M.—Quoted by Sperino (see no. 47).
68. Blumenbach, J. F.—Quoted by Humphry (see no. 26).
69. Hermes, O.—Verh. Berl. Gesell. f. Anthrop. 1876, p. 88.
70. Johnstone, G. L.—Proc. Zool. Soc. London, 1897, p. 183.
71. Doran, A.—Trans. Linn. Soc. 1897, pp. 371–497.
72. Halford, G. B.—"Not like Man bimanous and biped, not yet quadrumanous, but cheiropodous." Melbourne, 1863.
73. Gruber, W.—Arch. f. Anat. 1870, p. 501.
74. Herrmann, G.—Journ. de l'Anat. et de la Physiol. norm. et path. 1880, pp. 434, 451, 472.
75. Owen, R.—Proc. Zool. Soc. London, 1836, pp. 41–42.
76. ,, Proc. Zool. Soc. London, 1846, pp. 2–3.
77. Schmidt, M.—"Die Krankheiten der Affen." Zool. Clinik. Berlin, 1870.
78. Rollet, E.—C. R. Ac. Paris, 1891, pp. 1476–1478.
79. Meyer, A. B.—Mitth. Zool. Mus. Dresden, 1877, pp. 223–247.
80. Pocock, R. I.—Proc. Zool. Soc. London, 1905, p. 169.

EXPLANATION OF THE PLATES.

Plate I.

Fig. A. The external ear.
B. The auricular cartilage.
C. The external generative organs. Letters in text.

Plate II.

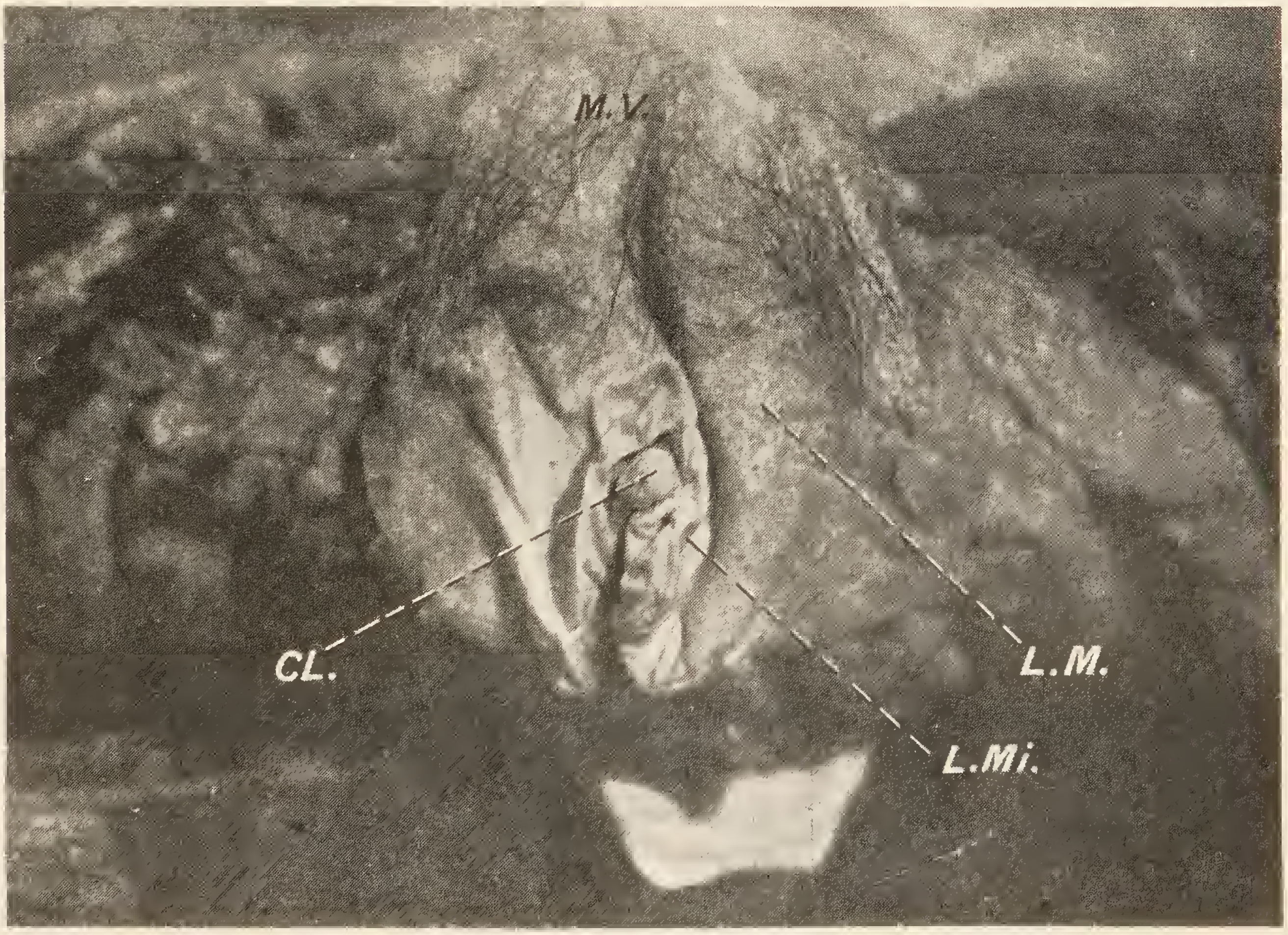
Fig. A. The turbinate region. Letters in text.
B. The antrum of Highmore. Description in text.

Plate III.

Fig. A. The hair shaft.
Figs. B & C. Sections through the skin and the root of a hair.

A

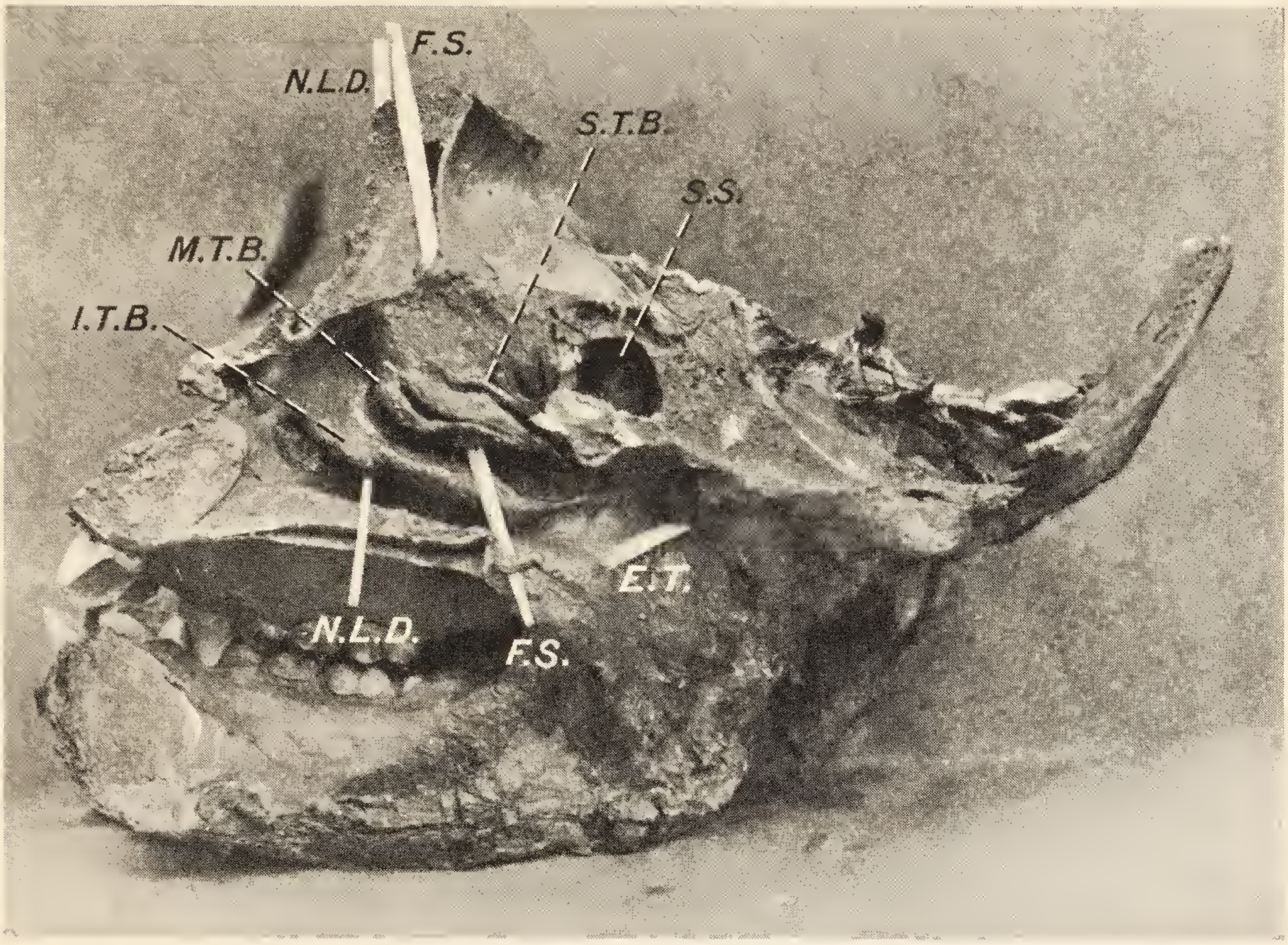
B



C

John Bale, Sons & Danielsson, Ltd

ANATOMY OF THE CHIMPANZEE.

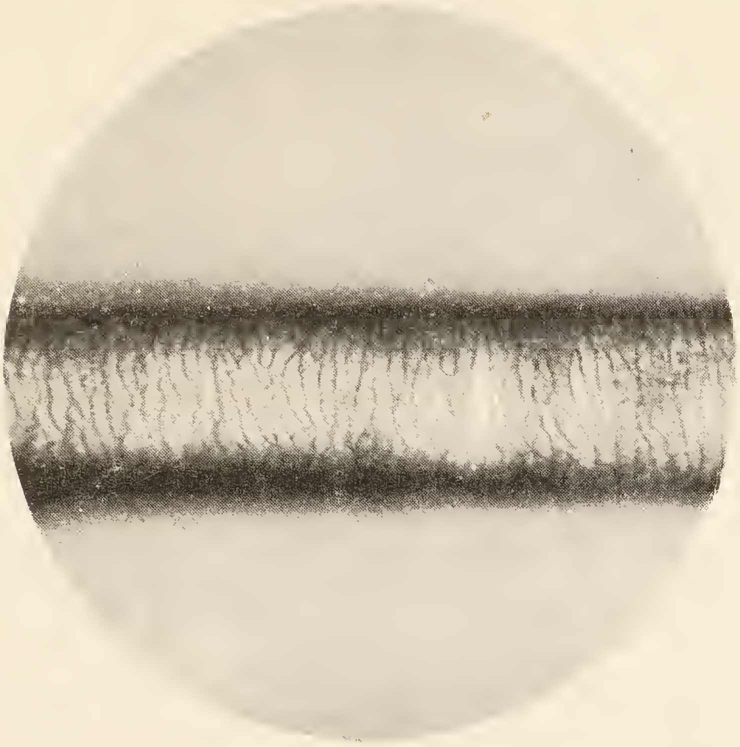


A

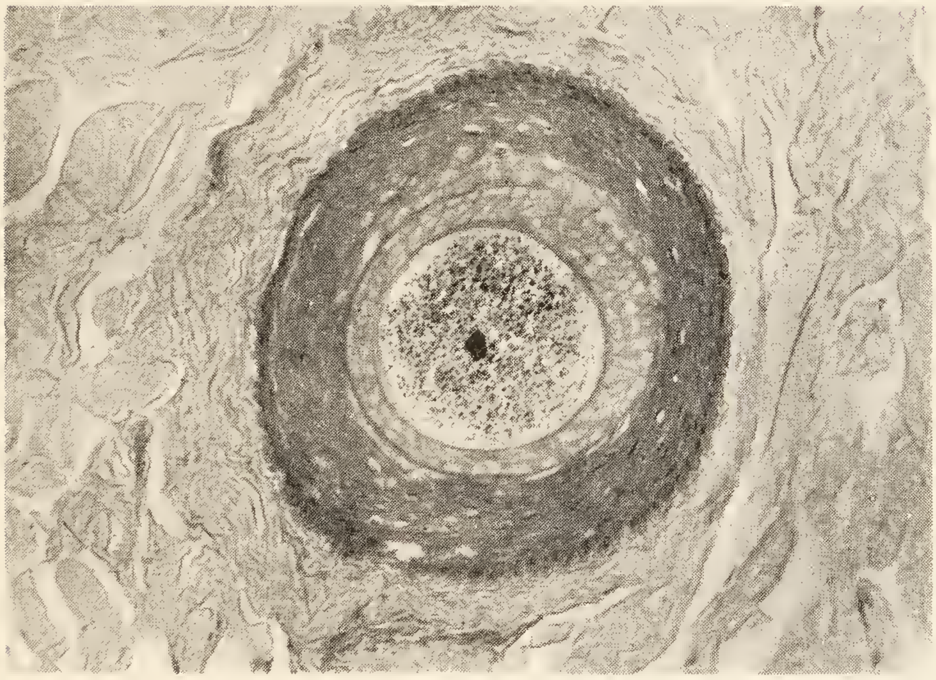
B

John Bale, Sons & Danielsson, Ltd.

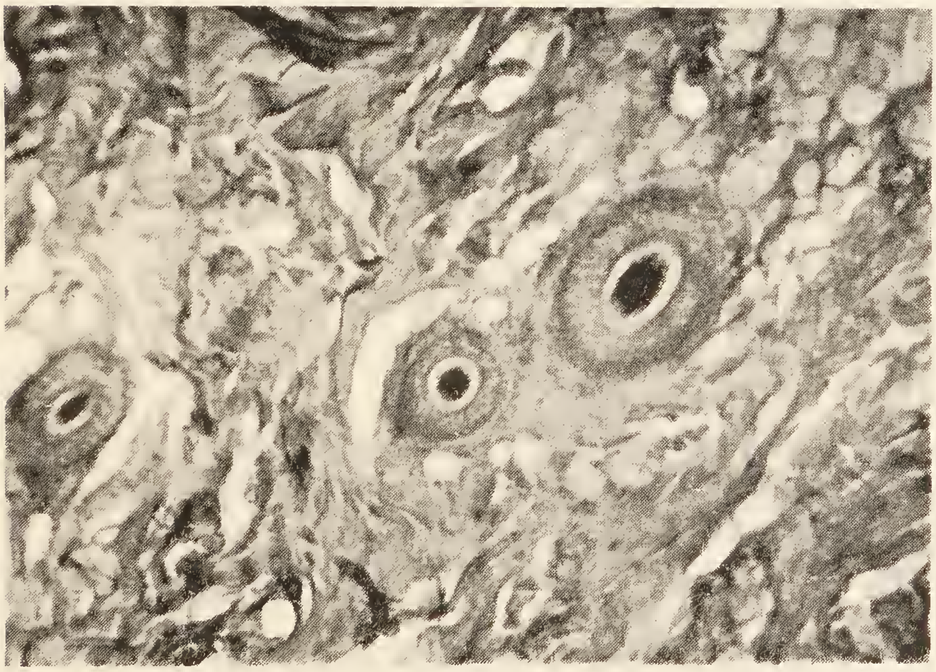
ANATOMY OF THE CHIMPANZEE.



A



B



C

John Bale, Sons & Danielsson, L^td

ANATOMY OF THE CHIMPANZEE.